Materials used for engineering

- Iron and steel are also called ferrous metal
- Ferrum – iron
- Non ferrous metals such as brass, copper, aluminium, tin etc.
- Wood and timber, plastics, rubber etc.
- Building materials like bricks, cement, concrete, etc.

Alloy

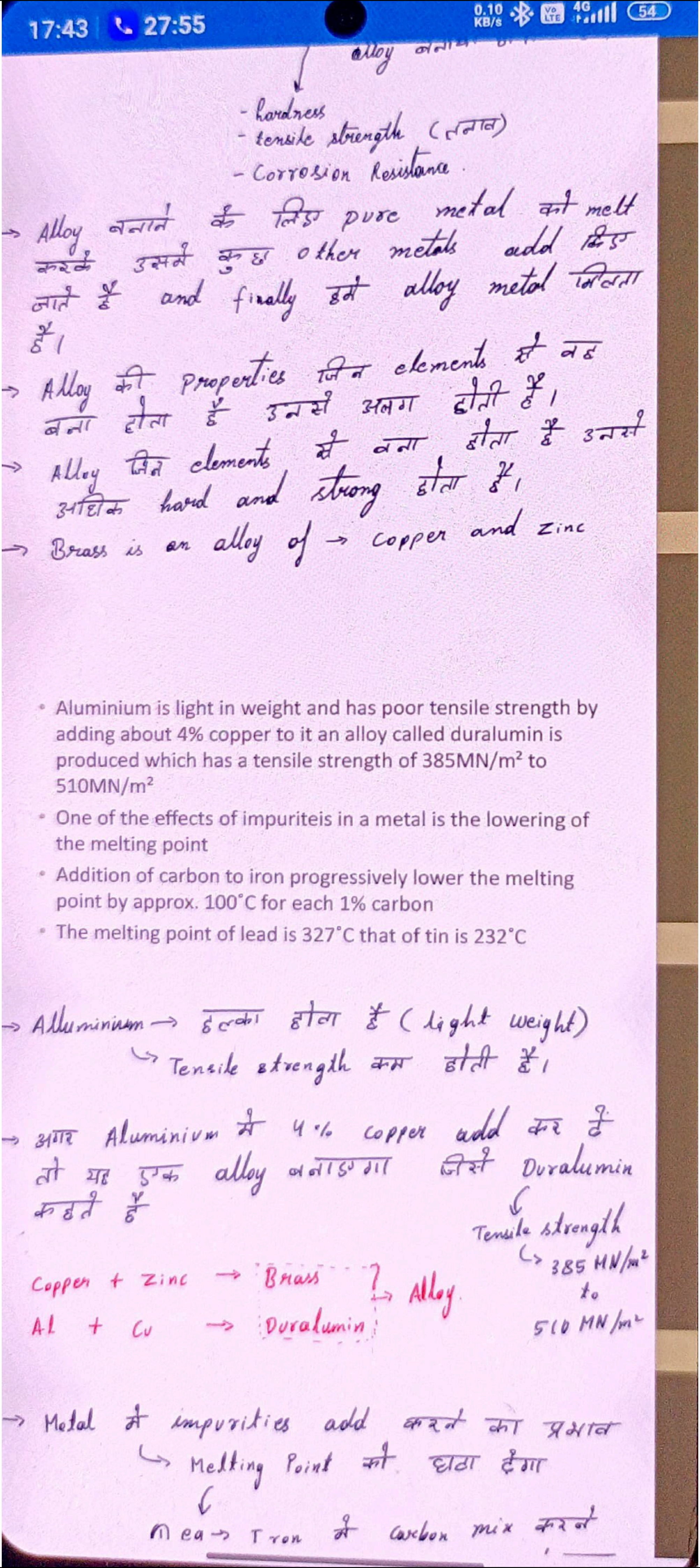
- To enhance properties like hardness, tensile strength, corrosion resistance etc. a pure metal is melted with small additions of other metals or substances and resultant metal is an alloy
- An alloy is defined as a metal which is a mixture of two or more elements that mix together when molten, and do not separate upon cooling
- Properties of alloy are much different from those of the elements which make it
- Alloys are harder and stronger than the elements they contain
- Brass is an alloy of copper and zinc

→ ठंडा होने पर अलग नही होते है।

→ Alloy क्यों बनाते है? → किसी भी metal की क्षमता बढ़ाने के लि
alloy बनाया जाता है।

- hardness
- tensile strength (तनाव)
- Corrosion Resistance.

→ Alloy बनाने के लिए pure metal को melt करके उसमे कुछ other metals add किए जाते है and finally हमे alloy metal मिलता



alloy बना

- hardness
- tensile strength (तनाव)
- Corrosion Resistance.

→ Alloy बनाने के लिए pure metal को melt करके उसमें कुछ other metals add किए जाते हैं and finally हमें alloy metal मिलता है।

→ Alloy की properties जिन elements से वह बना होता है उनसे अलग होती है।

→ Alloy जिन elements से बना होता है उनसे अधिक hard and strong होता है।

→ Brass is an alloy of → copper and zinc

- Aluminium is light in weight and has poor tensile strength by adding about 4% copper to it an alloy called duralumin is produced which has a tensile strength of 385MN/m² to 510MN/m²
- One of the effects of impuriteis in a metal is the lowering of the melting point
- Addition of carbon to iron progressively lower the melting point by approx. 100˚C for each 1% carbon
- The melting point of lead is 327˚C that of tin is 232˚C

→ Alluminium → हल्का होता है (light weight)
↳ Tensile strength कम होती है।

→ अगर Aluminium में 4% copper add कर दें तो यह एक alloy बनाएगा जिसे Duralumin कहते हैं
Duralumin → Tensile strength ↳ 385 MN/m² to 510 MN/m²

Copper + Zinc → Brass
Al + Cu → Duralumin
→ Alloy.

→ Metal में impurities add करने का प्रभाव
↳ Melting Point को घटा देगा
Mea → Iron में carbon mix करने

385 MN/m
to
510 MN/m²

Copper + Zinc → Brass } → Alloy
Al + Cu → Duralumin

→ Metal में impurities add करने का प्रभाव
↳ Melting Point को घटा देगा
↓
① eg → Iron में carbon mix करने Iron का melting point घट जाता है
↳ 1% carbon पर approx. 100°C कम हो जाता है।

② eg → Lead → 327°C mp
Tin → 232°C mp } → mixture → solder → 180°C mp.

Ferrous metal

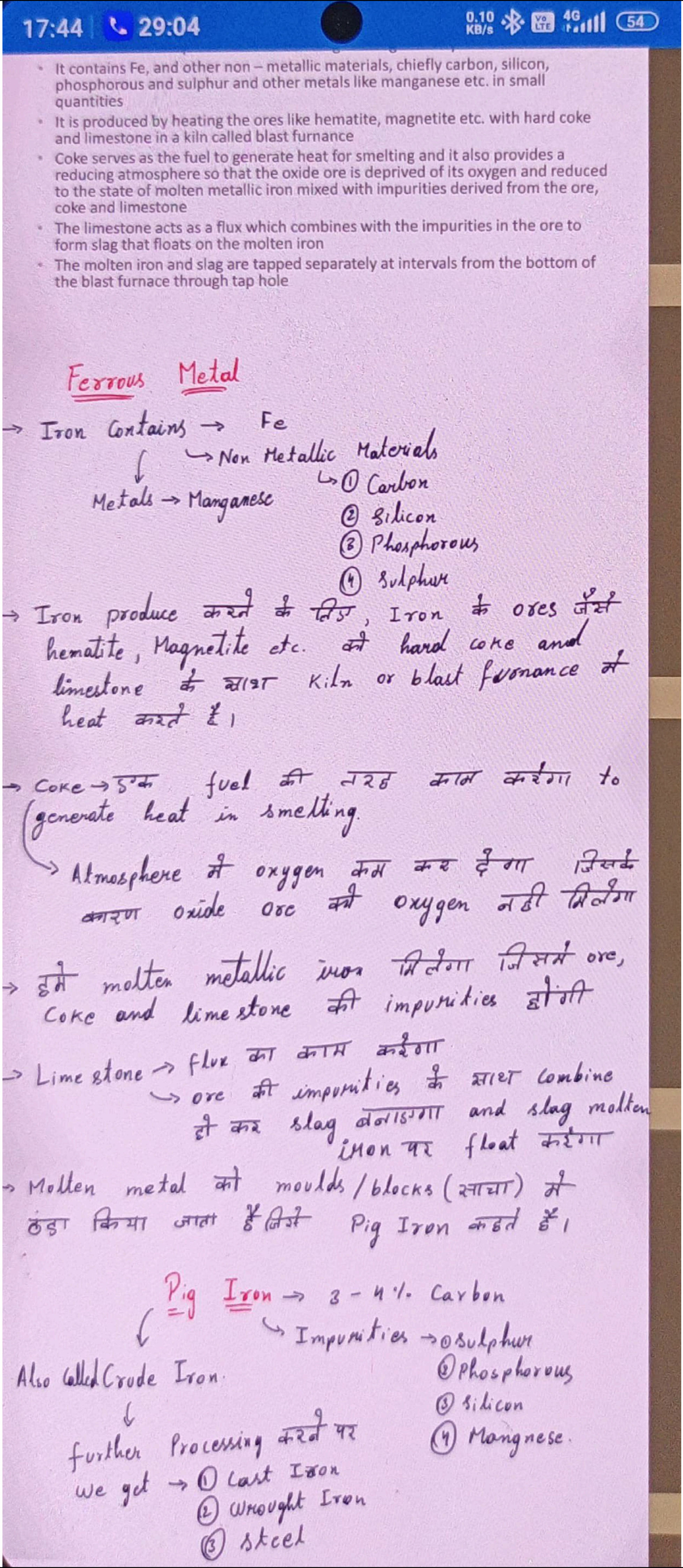
- Iron is the most important material in engineering industry
- It contains Fe, and other non – metallic materials, chiefly carbon, silicon, phosphorous and sulphur and other metals like manganese etc. in small quantities
- It is produced by heating the ores like hematite, magnetite etc. with hard coke and limestone in a kiln called blast furnance
- Coke serves as the fuel to generate heat for smelting and it also provides a reducing atmosphere so that the oxide ore is deprived of its oxygen and reduced to the state of molten metallic iron mixed with impurities derived from the ore, coke and limestone
- The limestone acts as a flux which combines with the impurities in the ore to form slag that floats on the molten iron
- The molten iron and slag are tapped separately at intervals from the bottom of the blast furnace through tap hole

Ferrous Metal

→ Iron Contains → Fe
↳ Non Metallic Materials
↳ ① Carbon
② Silicon
③ Phosphorous
④ Sulphur
↓
Metals → Manganese

→ Iron produce करने के लिए, Iron के ores जैसे hematite, Magnetite etc. को hard coke and limestone के साथ Kiln or blast furnance में heat करते हैं।

→ Coke → एक fuel की तरह काम करेगा to generate heat in smelting.
↳ Atmosphere में oxygen कम कर देगा जिसके
-/ ... को oxygen नहीं मिलेगा



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→ Coke → एक fuel की तरह काम करेगा to generate heat in smelting.
↳ Atmosphere मे oxygen कम कर देगा जिसके कारण oxide ore को oxygen नही मिलेगा

→ हमे molten metallic iron मिलेगा जिसमें ore, Coke and lime stone की impurities होंगी

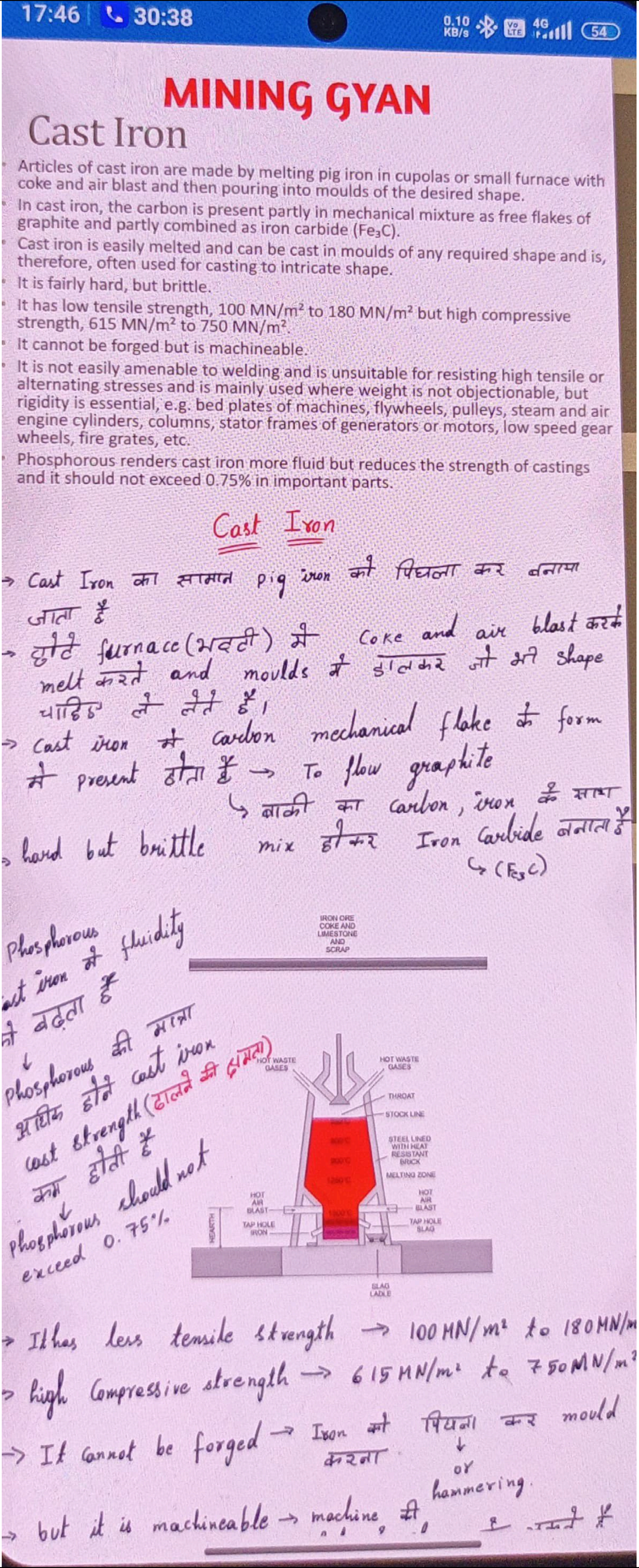
→ Lime stone → flux का काम करेगा
↳ ore की impurities के साथ combine हो कर slag बनाएगा and slag molten iron पर float करेगा

→ Molten metal को moulds/blocks (साचा) मे ठंडा किया जाता है जिसे Pig Iron कहते है।

Pig Iron → 3 - 4 % Carbon

↳ Impurities → ① Sulphur
② Phosphorous
③ Silicon
④ Mangnese.

↓
Also called Crude Iron.
↓
further Processing करने पर we get → ① Cast Iron
② Wrought Iron
③ steel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MINING GYAN

Cast Iron

- Articles of cast iron are made by melting pig iron in cupolas or small furnace with coke and air blast and then pouring into moulds of the desired shape.
- In cast iron, the carbon is present partly in mechanical mixture as free flakes of graphite and partly combined as iron carbide (Fe_3C).
- Cast iron is easily melted and can be cast in moulds of any required shape and is, therefore, often used for casting to intricate shape.
- It is fairly hard, but brittle.
- It has low tensile strength, 100 MN/m² to 180 MN/m² but high compressive strength, 615 MN/m² to 750 MN/m².
- It cannot be forged but is machineable.
- It is not easily amenable to welding and is unsuitable for resisting high tensile or alternating stresses and is mainly used where weight is not objectionable, but rigidity is essential, e.g. bed plates of machines, flywheels, pulleys, steam and air engine cylinders, columns, stator frames of generators or motors, low speed gear wheels, fire grates, etc.
- Phosphorous renders cast iron more fluid but reduces the strength of castings and it should not exceed 0.75% in important parts.

Cast Iron

→ Cast Iron का सामान pig iron को पिघला कर बनाया जाता है

→ छोटे furnace (भट्टी) में coke and air blast करके melt करते and moulds में डालकर जो भी shape चाहिए ले लेते हैं।

→ cast iron में carbon mechanical flake के form में present होता है → To flow graphite
↳ बाकी का carbon, iron के साथ mix होकर Iron Carbide बनाता है
↳ (Fe_3C)

→ hard but brittle

Phosphorous cast iron में fluidity को बढ़ता है
↓
phosphorous की मात्रा अधिक होने cast iron cast strength (ढालने की क्षमता) कम होती है
↓
phosphorous should not exceed 0.75%

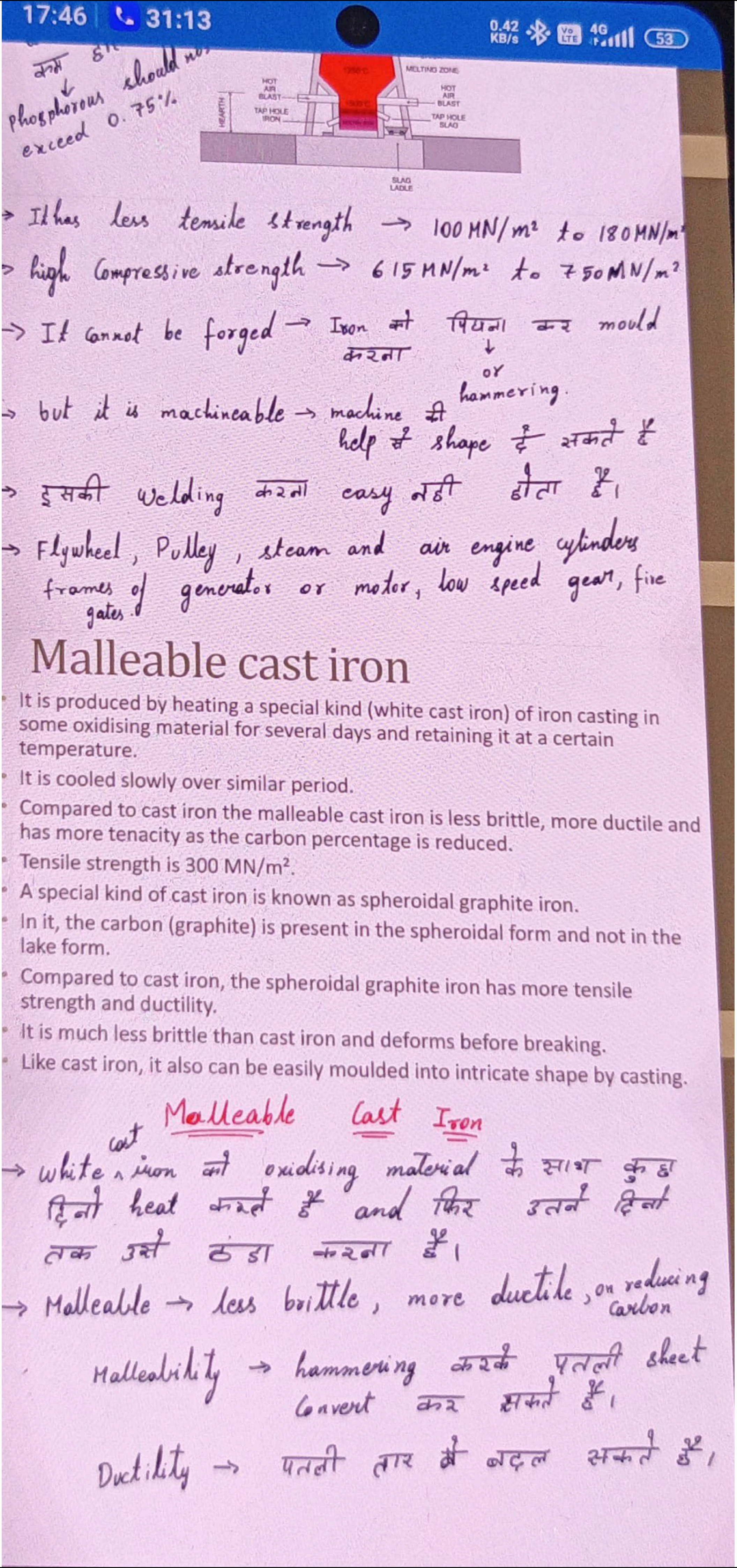
IRON ORE COKE AND LIMESTONE AND SCRAP
HOT WASTE GASES
HOT WASTE GASES
THROAT
STOCK LINE
STEEL LINED WITH HEAT RESISTANT BRICK
MELTING ZONE
HOT AIR BLAST
HOT AIR BLAST
TAP HOLE IRON
TAP HOLE SLAG
HEARTH
SLAG LADLE

→ It has less tensile strength → 100 MN/m² to 180 MN/m²

→ high Compressive strength → 615 MN/m² to 750 MN/m²

→ It cannot be forged → Iron को पिघला कर mould करना
↓
or
hammering.

→ but it is machineable → machine से [illegible] है



कम हो ... should not
↓
phosphorous exceed 0.75%

→ It has less tensile strength → 100 MN/m² to 180 MN/m²

→ high Compressive strength → 615 MN/m² to 750 MN/m²

→ It cannot be forged → Iron को पिघला कर mould करना
↓
or
hammering.

→ but it is machineable → machine की help से shape दे सकते है

→ इसकी welding करना easy नहीं होता है।

→ Flywheel, Pulley, steam and air engine cylinders frames of generator or motor, low speed gear, fire gates.

Malleable cast iron

- It is produced by heating a special kind (white cast iron) of iron casting in some oxidising material for several days and retaining it at a certain temperature.
- It is cooled slowly over similar period.
- Compared to cast iron the malleable cast iron is less brittle, more ductile and has more tenacity as the carbon percentage is reduced.
- Tensile strength is 300 MN/m².
- A special kind of cast iron is known as spheroidal graphite iron.
- In it, the carbon (graphite) is present in the spheroidal form and not in the lake form.
- Compared to cast iron, the spheroidal graphite iron has more tensile strength and ductility.
- It is much less brittle than cast iron and deforms before breaking.
- Like cast iron, it also can be easily moulded into intricate shape by casting.

Malleable Cast Iron

→ white cast iron को oxidising material के साथ कुछ दिनों heat करते है and फिर उतने दिनों तक उसे ठंडा करना है।

→ Malleable → less brittle, more ductile, on reducing carbon

Malleability → hammering करके पतली sheet convert कर सकते है।

Ductility → पतली तार में बदल सकते है।

तक उसे ठंडा करना है।

→ Malleable → less brittle, more ductile, on reducing carbon

Malleability → hammering करके पतली sheet convert कर सकते है।

Ductility → पतली तार में बदल सकते है।

Spheroidal Graphite Iron

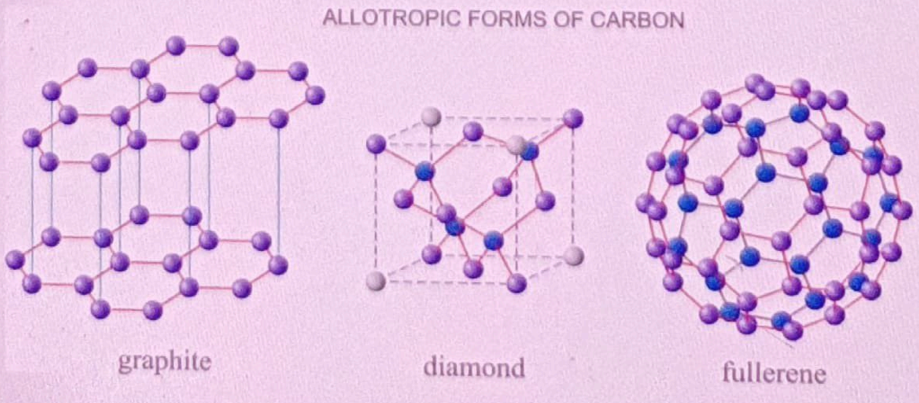
→ It is a special type of cast iron.

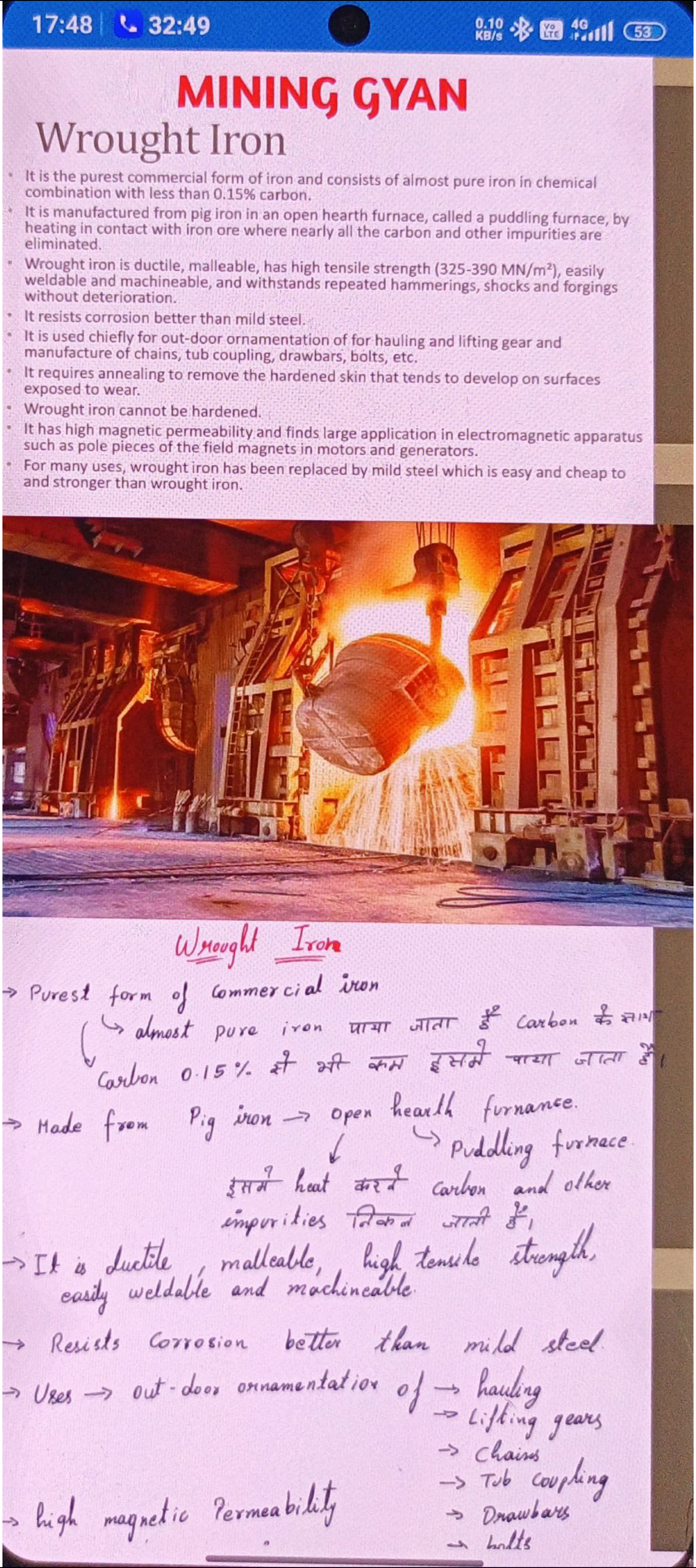
→ carbon (graphite) spheroidal form में होता है।

→ cast Iron के comparison में यह अधिक tensile and ductile होता है।

→ Less brittle & टूटने के पहले bend/deform होगा

→ जटिल casting किया जा सकता है।


ALLOTROPIC FORMS OF CARBON
graphite
diamond
fullerene



MINING GYAN

Wrought Iron

- It is the purest commercial form of iron and consists of almost pure iron in chemical combination with less than 0.15% carbon.
- It is manufactured from pig iron in an open hearth furnace, called a puddling furnace, by heating in contact with iron ore where nearly all the carbon and other impurities are eliminated.
- Wrought iron is ductile, malleable, has high tensile strength (325-390 MN/m^2), easily weldable and machineable, and withstands repeated hammerings, shocks and forgings without deterioration.
- It resists corrosion better than mild steel.
- It is used chiefly for out-door ornamentation of for hauling and lifting gear and manufacture of chains, tub coupling, drawbars, bolts, etc.
- It requires annealing to remove the hardened skin that tends to develop on surfaces exposed to wear.
- Wrought iron cannot be hardened.
- It has high magnetic permeability and finds large application in electromagnetic apparatus such as pole pieces of the field magnets in motors and generators.
- For many uses, wrought iron has been replaced by mild steel which is easy and cheap to and stronger than wrought iron.

Wrought Iron

→ Purest form of commercial iron
↳ almost pure iron पाया जाता है Carbon के साथ
Carbon 0.15% से भी कम इसमें पाया जाता है।

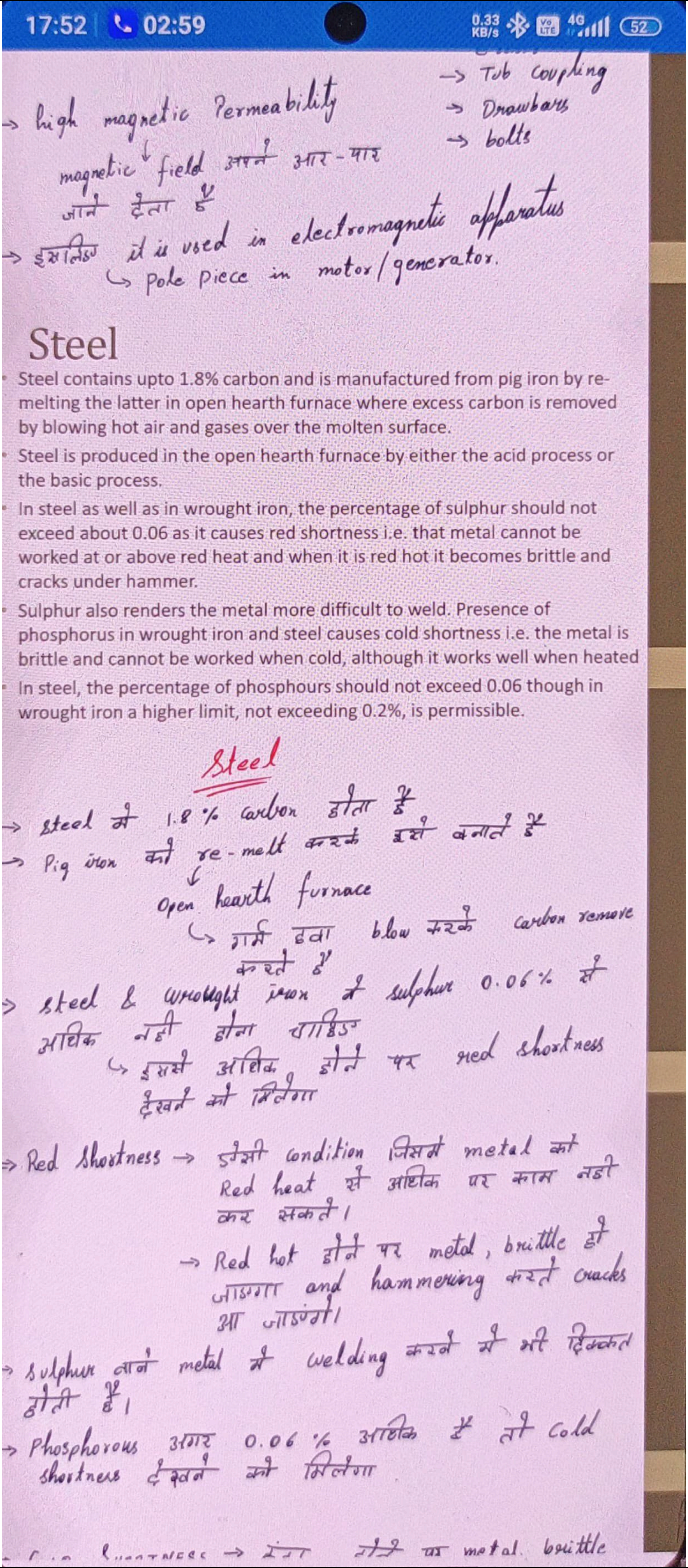
→ Made from Pig iron → open hearth furnance.
↳ Puddling furnace.
↓
इसमें heat करने carbon and other impurities निकल जाती हैं,

→ It is ductile, malleable, high tensile strength, easily weldable and machineable.

→ Resists Corrosion better than mild steel

→ Uses → out-door ornamentation of → hauling
→ Lifting gears
→ Chains
→ Tub coupling
→ Drawbars
→ bolts

→ high magnetic Permeability



→ Tub coupling
→ Drawbars
→ bolts

→ high magnetic Permeability
↓
magnetic field अपने आर-पार
जाने देता है

→ इसलिए it is used in electromagnetic apparatus
↳ Pole piece in motor/generator.

Steel

- Steel contains upto 1.8% carbon and is manufactured from pig iron by re-melting the latter in open hearth furnace where excess carbon is removed by blowing hot air and gases over the molten surface.
- Steel is produced in the open hearth furnace by either the acid process or the basic process.
- In steel as well as in wrought iron, the percentage of sulphur should not exceed about 0.06 as it causes red shortness i.e. that metal cannot be worked at or above red heat and when it is red hot it becomes brittle and cracks under hammer.
- Sulphur also renders the metal more difficult to weld. Presence of phosphorus in wrought iron and steel causes cold shortness i.e. the metal is brittle and cannot be worked when cold, although it works well when heated
- In steel, the percentage of phosphours should not exceed 0.06 though in wrought iron a higher limit, not exceeding 0.2%, is permissible.

Steel

→ steel मे 1.8 % carbon होता है
→ Pig iron को re-melt करके इसे बनाते है
↓
Open hearth furnace
↳ गर्म हवा blow करके carbon remove करते है

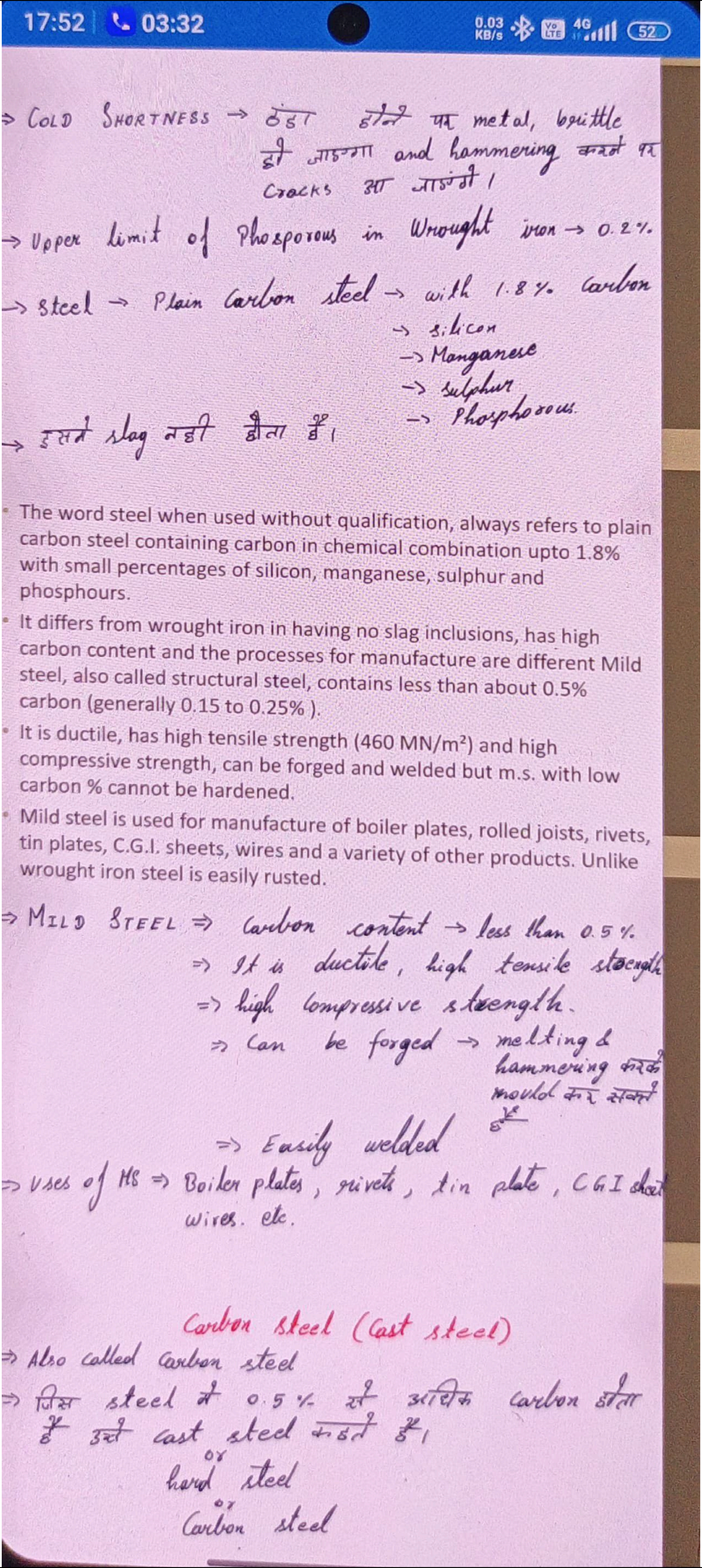
→ steel & wrought iron मे sulphur 0.06 % से अधिक नही होना चाहिए
↳ इससे अधिक होने पर red shortness देखने को मिलेगा

⇒ Red Shortness → ऐसी condition जिसमे metal को Red heat से अधिक पर काम नही कर सकते।
→ Red hot होने पर metal, brittle हो जाएगा and hammering करते cracks आ जाएंगी।

→ sulphur वाले metal मे welding करने मे भी दिक्कत होती है।

→ Phosphorous अगर 0.06 % अधिक है तो Cold shortness देखने को मिलेगा

Shortness → ठंडा होने पर metal brittle



⇒ COLD SHORTNESS → ठंडा होने पर metal, brittle
हो जाएगा and hammering करने पर
cracks आ जाएंगे।

→ Upper limit of Phosporous in Wrought iron → 0.2%.

→ steel → Plain carbon steel → with 1.8% carbon
→ silicon
→ Manganese
→ sulphur
→ Phosphorous.

→ इसमें slag नहीं होता है।

- The word steel when used without qualification, always refers to plain carbon steel containing carbon in chemical combination upto 1.8% with small percentages of silicon, manganese, sulphur and phosphours.
- It differs from wrought iron in having no slag inclusions, has high carbon content and the processes for manufacture are different Mild steel, also called structural steel, contains less than about 0.5% carbon (generally 0.15 to 0.25%).
- It is ductile, has high tensile strength (460 MN/m^2) and high compressive strength, can be forged and welded but m.s. with low carbon % cannot be hardened.
- Mild steel is used for manufacture of boiler plates, rolled joists, rivets, tin plates, C.G.I. sheets, wires and a variety of other products. Unlike wrought iron steel is easily rusted.

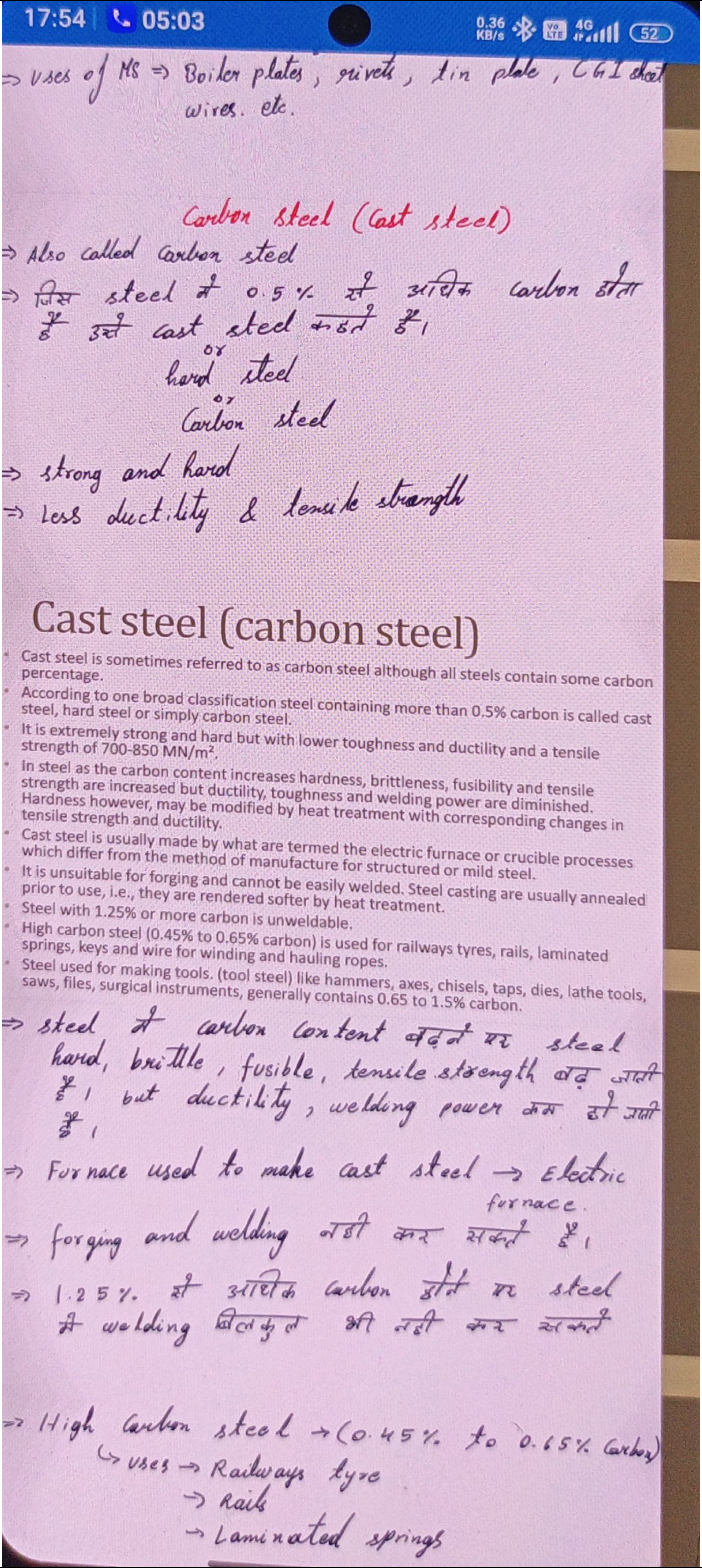
⇒ MILD STEEL ⇒ Carbon content → less than 0.5%.
⇒ It is ductile, high tensile strength
⇒ high compressive strength.
⇒ Can be forged → melting & hammering करके mould कर सकते हैं
⇒ Easily welded

⇒ Uses of MS ⇒ Boiler plates, rivets, tin plate, CGI sheet
wires. etc.

Carbon steel (Cast steel)

⇒ Also called Carbon steel

⇒ जिस steel में 0.5% से अधिक carbon होता है उसे cast steel कहते हैं।
or
hard steel
or
Carbon steel



⇒ uses of MS ⇒ Boiler plates, rivets, tin plate, CGI sheet
wires. etc.

Carbon steel (Cast steel)

⇒ Also called carbon steel

⇒ जिस steel में 0.5% से अधिक carbon होता है उसे cast steel कहते है।
or
hard steel
or
Carbon steel

⇒ strong and hard

⇒ Less ductility & tensile strength

Cast steel (carbon steel)

- Cast steel is sometimes referred to as carbon steel although all steels contain some carbon percentage.
- According to one broad classification steel containing more than 0.5% carbon is called cast steel, hard steel or simply carbon steel.
- It is extremely strong and hard but with lower toughness and ductility and a tensile strength of 700-850 MN/m^2.
- In steel as the carbon content increases hardness, brittleness, fusibility and tensile strength are increased but ductility, toughness and welding power are diminished. Hardness however, may be modified by heat treatment with corresponding changes in tensile strength and ductility.
- Cast steel is usually made by what are termed the electric furnace or crucible processes which differ from the method of manufacture for structured or mild steel.
- It is unsuitable for forging and cannot be easily welded. Steel casting are usually annealed prior to use, i.e., they are rendered softer by heat treatment.
- Steel with 1.25% or more carbon is unweldable.
- High carbon steel (0.45% to 0.65% carbon) is used for railways tyres, rails, laminated springs, keys and wire for winding and hauling ropes.
- Steel used for making tools. (tool steel) like hammers, axes, chisels, taps, dies, lathe tools, saws, files, surgical instruments, generally contains 0.65 to 1.5% carbon.

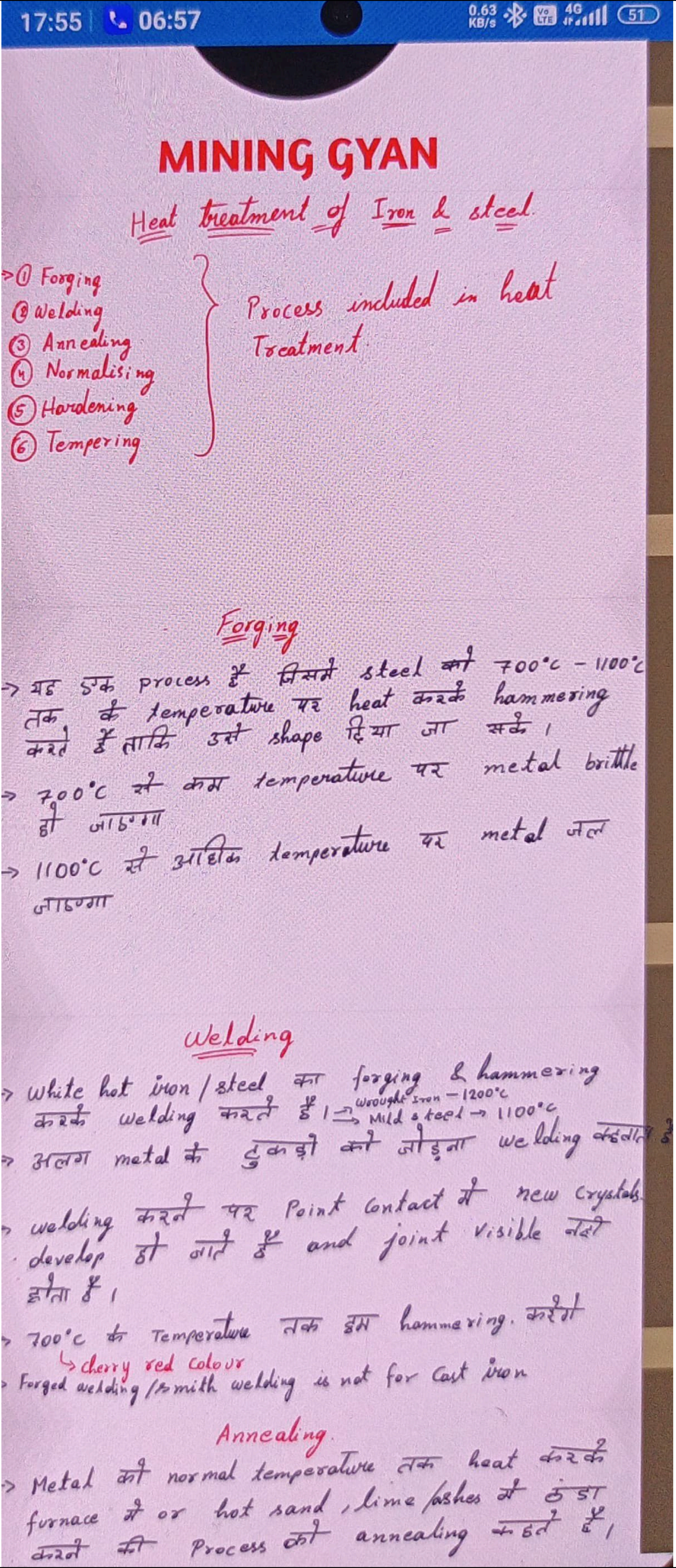
⇒ steel में carbon content बढ़ने पर steel hard, brittle, fusible, tensile strength बढ़ जाती है। but ductility, welding power कम हो जाती है।

⇒ Furnace used to make cast steel → Electric furnace.

⇒ forging and welding नहीं कर सकते है।

⇒ 1.25% से अधिक carbon होने पर steel में welding बिलकुल भी नहीं कर सकते

⇒ High carbon steel → (0.45% to 0.65% carbon)
↳ uses → Railways tyre
→ Rails
→ Laminated springs



MINING GYAN

Heat treatment of Iron & steel

- ① Forging
- ② Welding
- ③ Annealing
- ④ Normalising
- ⑤ Hardening
- ⑥ Tempering

} Process included in heat Treatment.

Forging

→ यह एक process है जिसमे steel को 700°c - 1100°c तक के temperature पर heat करके hammering करते है ताकि उसे shape दिया जा सके।

→ 700°C से कम temperature पर metal brittle हो जाएगा

→ 1100°C से अधिक temperature पर metal जल जाएगा

Welding

→ White hot iron/steel का forging & hammering करके welding करते है। → Wrought Iron – 1200°c
→ Mild steel → 1100°c

→ अलग metal के टुकड़ो को जोड़ना welding कहलाते है

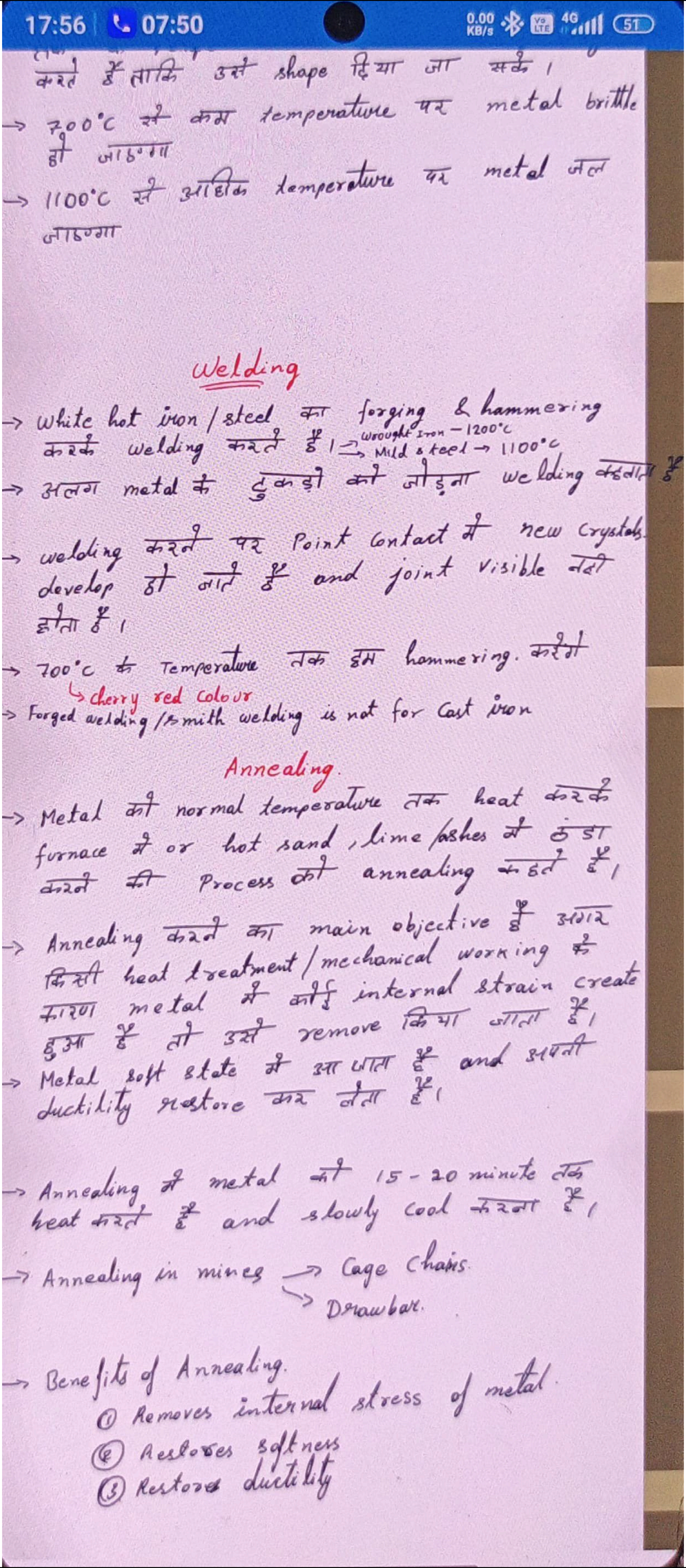
→ welding करने पर Point contact मे new crystals develop हो जाते है and joint visible नही होता है।

→ 700°c के Temperature तक हम hammering करेंगे
↳ cherry red colour

→ Forged welding/smith welding is not for Cast iron

Annealing

→ Metal को normal temperature तक heat करके furnace मे or hot sand, lime/ashes मे ठंडा करने की Process को annealing कहते है।



करते हैं ताकि उसे shape दिया जा सके।

-> 700°C से कम temperature पर metal brittle हो जाएगा

-> 1100°C से अधिक temperature पर metal जल जाएगा

Welding

-> White hot iron / steel का forging & hammering करके welding करते हैं। -> Wrought iron - 1200°C -> Mild steel -> 1100°C

-> अलग metal के टुकड़ों को जोड़ना welding कहलाता है

-> welding करने पर Point Contact में new Crystals develop हो जाते हैं and joint visible नहीं होता है।

-> 700°C के Temperature तक हम hammering करेंगे
↳ cherry red colour

-> Forged welding / smith welding is not for Cast iron

Annealing.

-> Metal को normal temperature तक heat करके furnace में or hot sand, lime / ashes में ठंडा करने की Process को annealing कहते हैं।

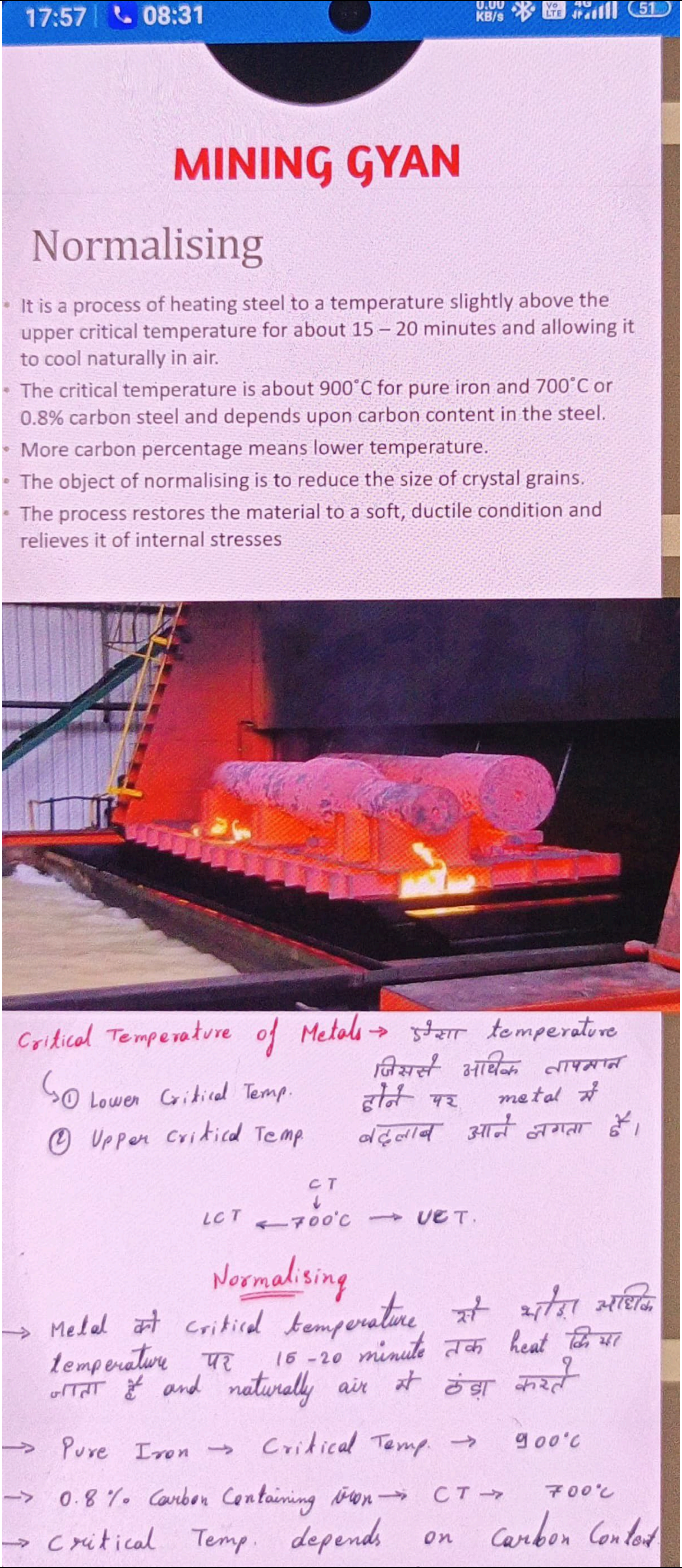
-> Annealing करने का main objective है अगर किसी heat treatment / mechanical working के कारण metal में कोई internal strain create हुआ है तो उसे remove किया जाता है।

-> Metal soft state में आ जाता है and अपनी ductility restore कर लेता है।

-> Annealing में metal को 15 - 20 minute तक heat करते हैं and slowly cool करना है।

-> Annealing in mines -> Cage Chains
-> Drawbar.

-> Benefits of Annealing.
① Removes internal stress of metal.
② Restores softness
③ Restores ductility



MINING GYAN

Normalising

- It is a process of heating steel to a temperature slightly above the upper critical temperature for about 15 – 20 minutes and allowing it to cool naturally in air.
- The critical temperature is about 900˚C for pure iron and 700˚C or 0.8% carbon steel and depends upon carbon content in the steel.
- More carbon percentage means lower temperature.
- The object of normalising is to reduce the size of crystal grains.
- The process restores the material to a soft, ductile condition and relieves it of internal stresses

Critical Temperature of Metals → ऐसा temperature जिससे अधिक तापमान होने पर metal में बदलाव आने लगता है।

↳ ① Lower Critical Temp.

② Upper Critical Temp.

$$\begin{tikzcd} & \text{CT} \arrow[d] & \\ \text{LCT} & 700^\circ\text{C} \arrow[l] \arrow[r] & \text{UCT.} \end{tikzcd}$$

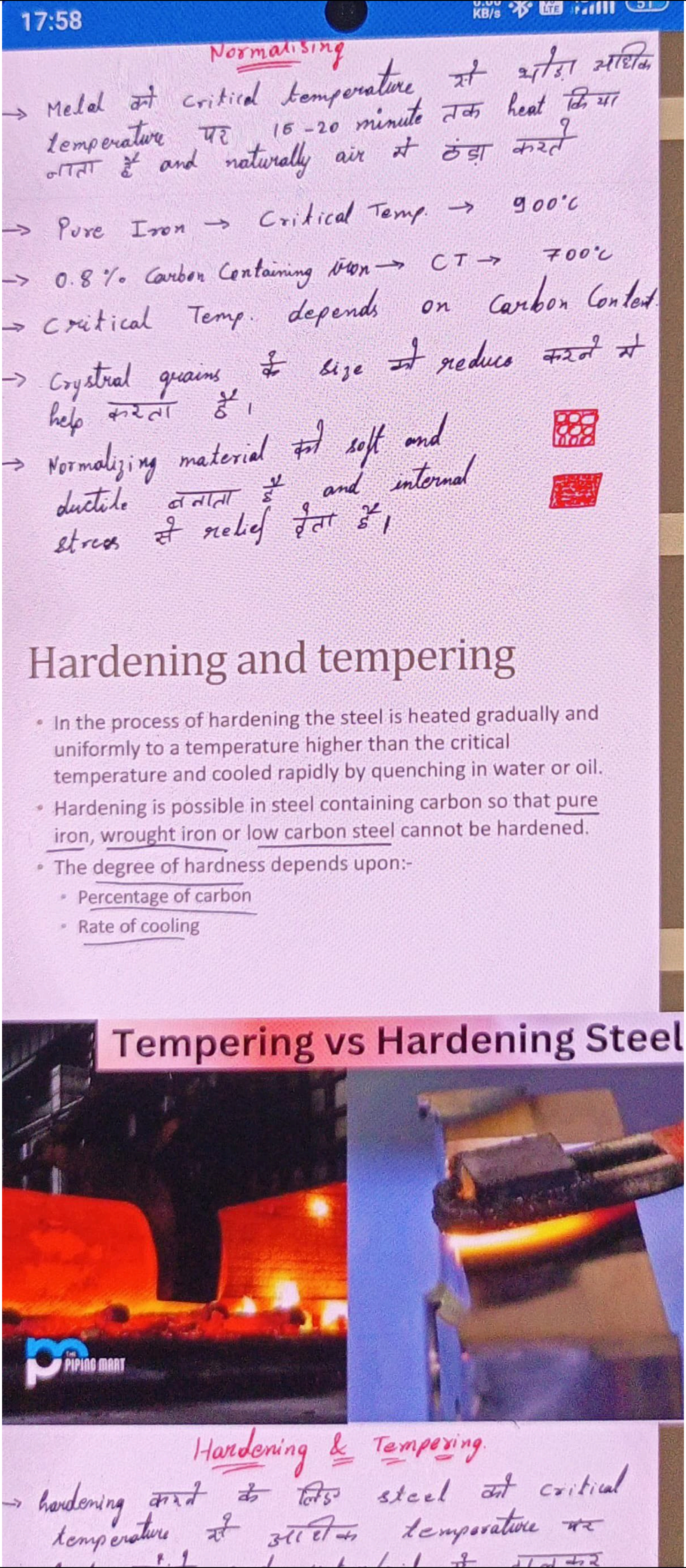
Normalising

→ Metal को critical temperature से थोड़ा अधिक temperature पर 15 - 20 minute तक heat किया जाता है and naturally air में ठंडा करते

→ Pure Iron → Critical Temp. → 900°C

→ 0.8 % Carbon Containing iron → CT → 700°C

→ Critical Temp. depends on Carbon Content



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→ Critical Temp. depends on Carbon Content

→ Crystal grains के size को reduce करने में help करता है।

→ Normalizing material को soft and ductile बनाता है and internal stress से relief देता है।

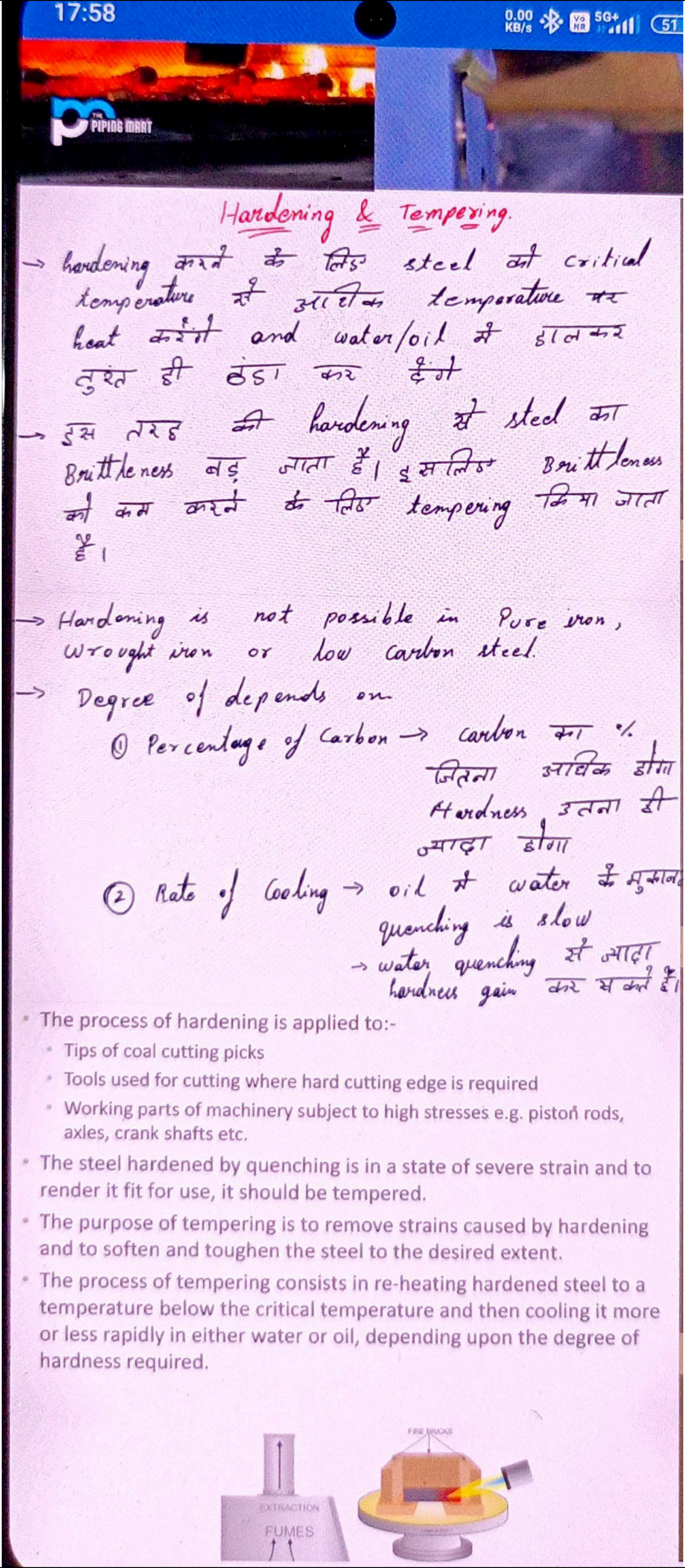
Hardening and tempering

- In the process of hardening the steel is heated gradually and uniformly to a temperature higher than the critical temperature and cooled rapidly by quenching in water or oil.
- Hardening is possible in steel containing carbon so that pure iron, wrought iron or low carbon steel cannot be hardened.
- The degree of hardness depends upon:-
  - Percentage of carbon
  - Rate of cooling

Tempering vs Hardening Steel

Hardening & Tempering

→ hardening करने के लिए steel को critical temperature से अधिक temperature पर



Hardening & Tempering.

→ hardening करने के लिए steel को critical temperature से अधिक temperature पर heat करेंगे and water/oil में डालकर तुरंत ही ठंडा कर देंगे

→ इस तरह की hardening से steel का Brittleness बढ़ जाता है। इसलिए Brittleness को कम करने के लिए tempering किया जाता है।

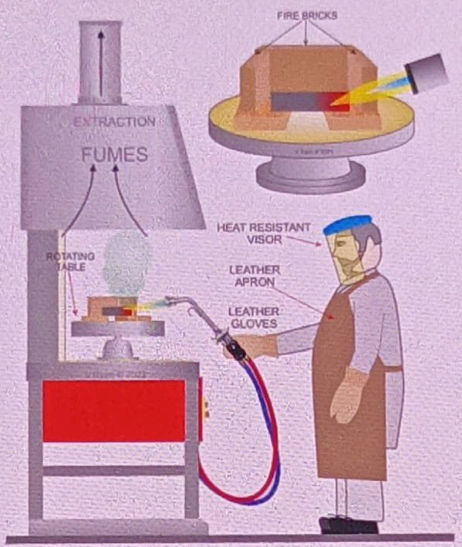
→ Hardening is not possible in Pure iron, Wrought iron or low carbon steel.

→ Degree of depends on

① Percentage of Carbon → carbon का % जितना अधिक होगा Hardness उतना ही ज्यादा होगा

② Rate of Cooling → oil से water के मुकाब quenching is slow
→ water quenching से ज्यादा hardness gain कर सकते है।

- The process of hardening is applied to:-
  - Tips of coal cutting picks
  - Tools used for cutting where hard cutting edge is required
  - Working parts of machinery subject to high stresses e.g. piston rods, axles, crank shafts etc.
- The steel hardened by quenching is in a state of severe strain and to render it fit for use, it should be tempered.
- The purpose of tempering is to remove strains caused by hardening and to soften and toughen the steel to the desired extent.
- The process of tempering consists in re-heating hardened steel to a temperature below the critical temperature and then cooling it more or less rapidly in either water or oil, depending upon the degree of hardness required.


FIRE BRICKS
EXTRACTION
FUMES
HEAT RESISTANT VISOR
ROTATING TABLE
LEATHER APRON
LEATHER GLOVES

→ Hardening किसका करते हैं →

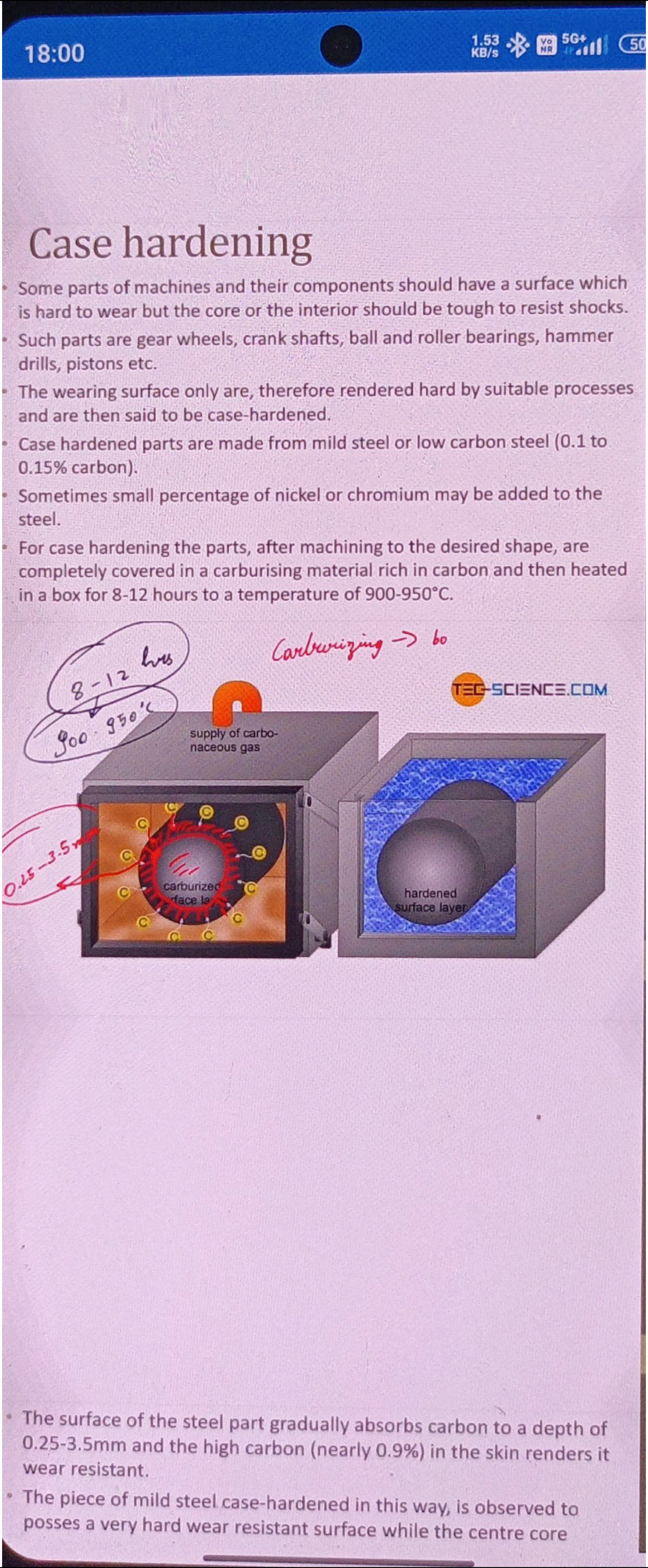
① coal cuttings picks के Tips.
② Cutting tools के edges को
③ Piston rod, axle, crank shaft
↳ working parts of machinery.

Tempering.

→ Hardened steel को दोबारा से re-heating करेंगे but below critical Temp. and जल्दी से oil/water cool करेंगे

→ Tempering करने पर ductility & toughness increase होता है।

- As the tempering temperature is gradually raised (but kept below the critical temperature) the ductility and toughness increases but hardness and tensile strength decrease.
- Engineering steels are tempered to a temperature ranging from 400°C to 650°C depending on the material and hardness required
- Drill steels and miner's picks, after they have been reshaped by forging at about 1000°C and allowed to cool slowly in air, are generally hardened and tempered in one operation.
- These tools generally are of plain carbon steel with 0.60 to 0.75% carbon.



Case hardening

- Some parts of machines and their components should have a surface which is hard to wear but the core or the interior should be tough to resist shocks.
- Such parts are gear wheels, crank shafts, ball and roller bearings, hammer drills, pistons etc.
- The wearing surface only are, therefore rendered hard by suitable processes and are then said to be case-hardened.
- Case hardened parts are made from mild steel or low carbon steel (0.1 to 0.15% carbon).
- Sometimes small percentage of nickel or chromium may be added to the steel.
- For case hardening the parts, after machining to the desired shape, are completely covered in a carburising material rich in carbon and then heated in a box for 8-12 hours to a temperature of 900-950°C.

8-12 hrs
900-950°C

Carburizing -> bo

0.25-3.5mm

- The surface of the steel part gradually absorbs carbon to a depth of 0.25-3.5mm and the high carbon (nearly 0.9%) in the skin renders it wear resistant.
- The piece of mild steel case-hardened in this way, is observed to posses a very hard wear resistant surface while the centre core

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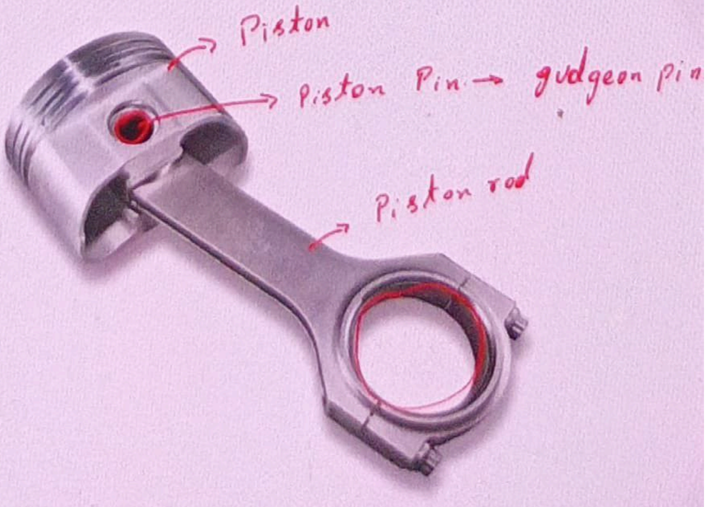
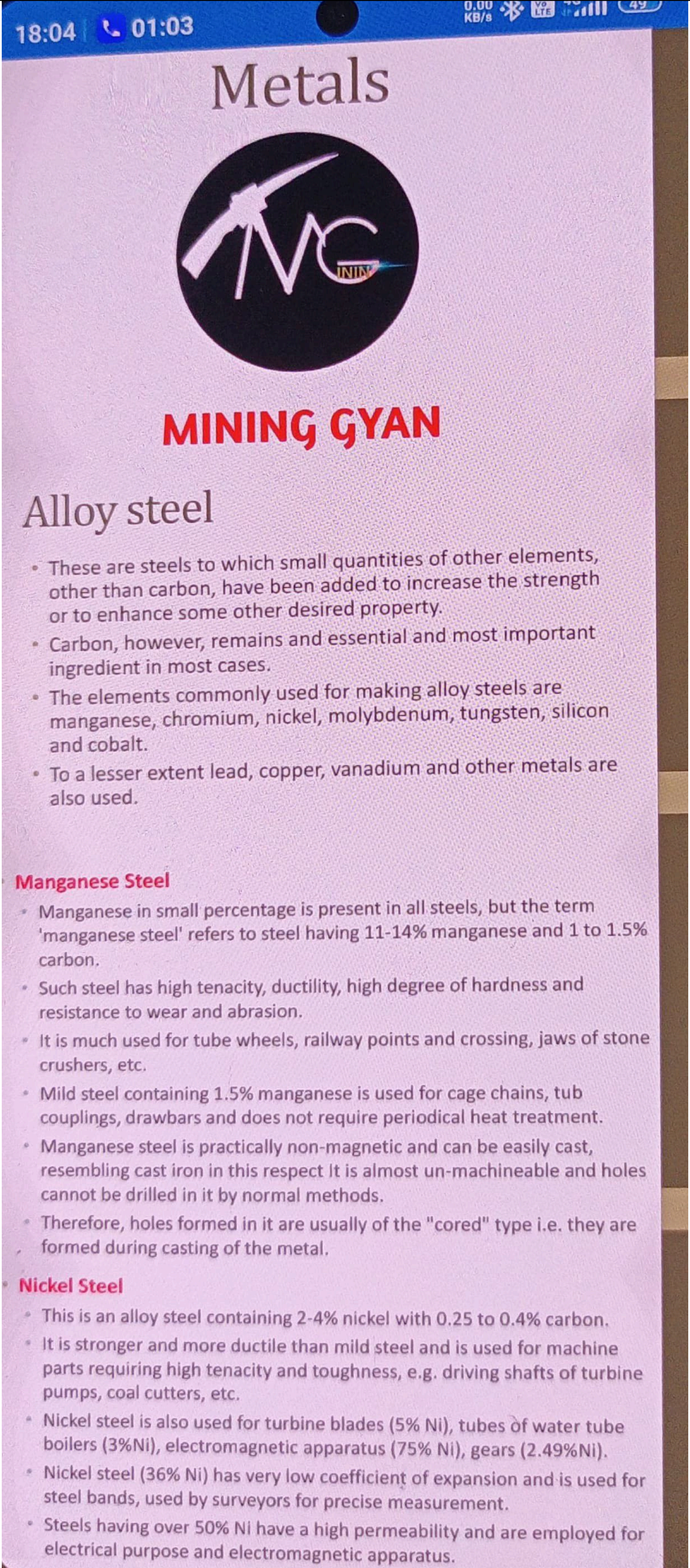
- The carburising medium is bone charcoal, leather, petroleum coke mixed with a little barium carbonate, potassium cyanide or sodium cyanide.
- If a case-hardened object is reheated to a temperature not exceeding 300°C and then quenched, the hardness of the outer layer is hardly affected but its brittleness is considerably reduced.





Metals

MINING GYAN

Alloy steel

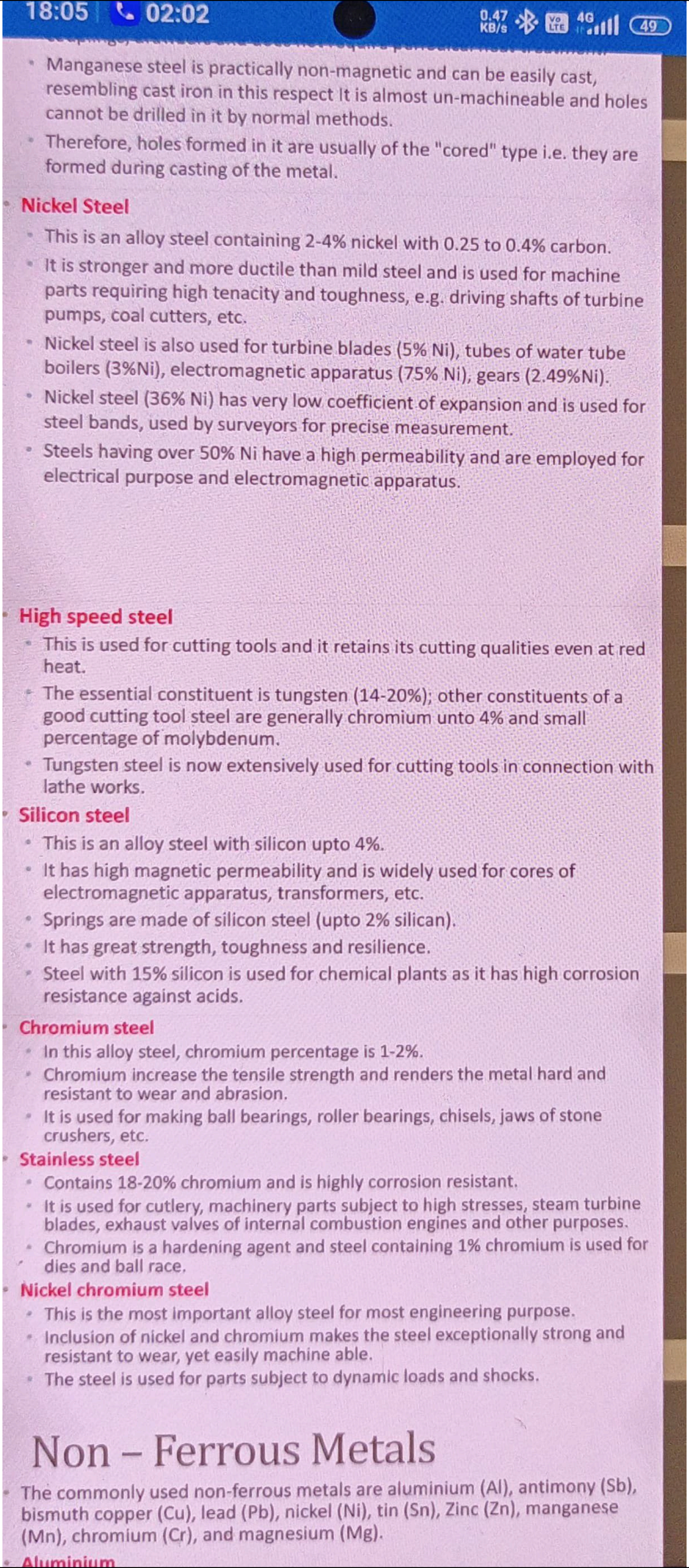
- These are steels to which small quantities of other elements, other than carbon, have been added to increase the strength or to enhance some other desired property.
- Carbon, however, remains and essential and most important ingredient in most cases.
- The elements commonly used for making alloy steels are manganese, chromium, nickel, molybdenum, tungsten, silicon and cobalt.
- To a lesser extent lead, copper, vanadium and other metals are also used.

Manganese Steel

- Manganese in small percentage is present in all steels, but the term 'manganese steel' refers to steel having 11-14% manganese and 1 to 1.5% carbon.
- Such steel has high tenacity, ductility, high degree of hardness and resistance to wear and abrasion.
- It is much used for tube wheels, railway points and crossing, jaws of stone crushers, etc.
- Mild steel containing 1.5% manganese is used for cage chains, tub couplings, drawbars and does not require periodical heat treatment.
- Manganese steel is practically non-magnetic and can be easily cast, resembling cast iron in this respect It is almost un-machineable and holes cannot be drilled in it by normal methods.
- Therefore, holes formed in it are usually of the "cored" type i.e. they are formed during casting of the metal.

Nickel Steel

- This is an alloy steel containing 2-4% nickel with 0.25 to 0.4% carbon.
- It is stronger and more ductile than mild steel and is used for machine parts requiring high tenacity and toughness, e.g. driving shafts of turbine pumps, coal cutters, etc.
- Nickel steel is also used for turbine blades (5% Ni), tubes of water tube boilers (3%Ni), electromagnetic apparatus (75% Ni), gears (2.49%Ni).
- Nickel steel (36% Ni) has very low coefficient of expansion and is used for steel bands, used by surveyors for precise measurement.
- Steels having over 50% Ni have a high permeability and are employed for electrical purpose and electromagnetic apparatus.



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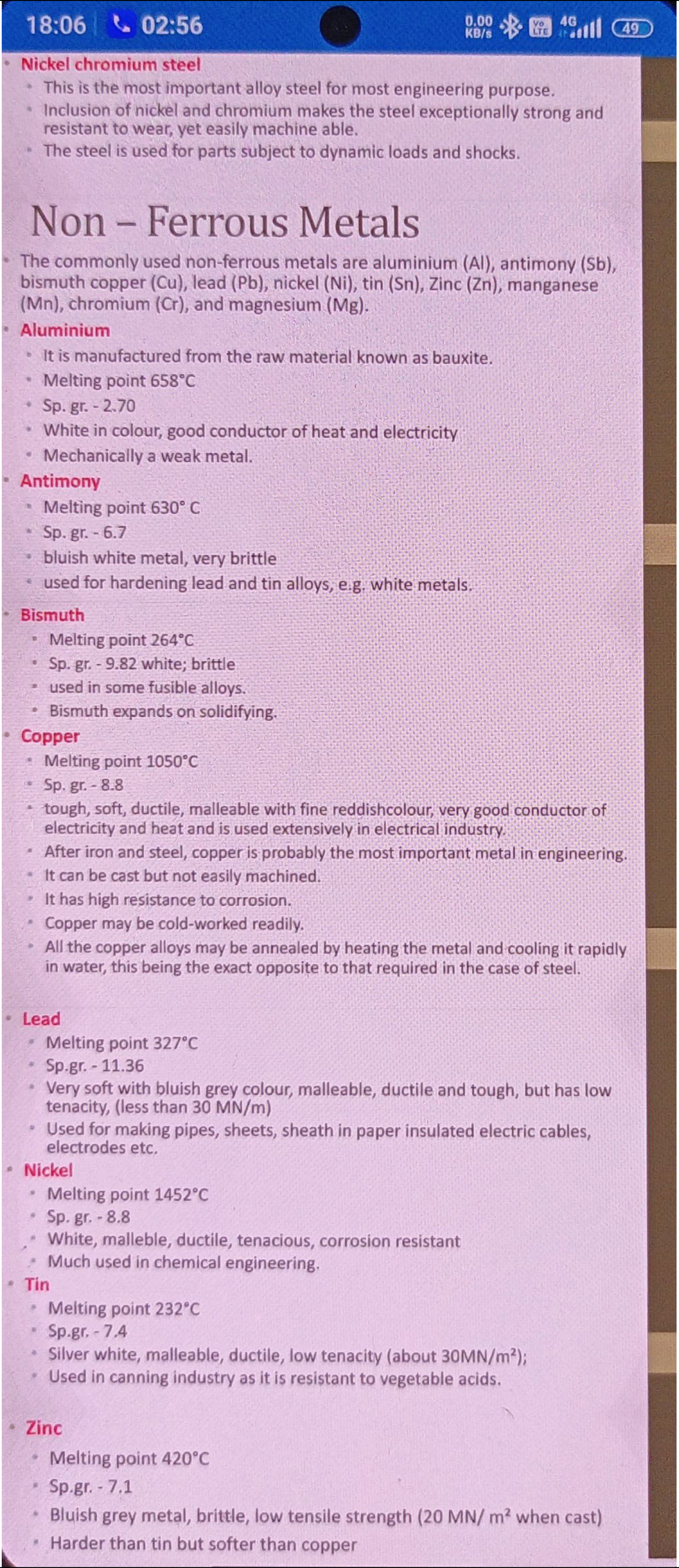
- **High speed steel**
  - This is used for cutting tools and it retains its cutting qualities even at red heat.
  - The essential constituent is tungsten (14-20%); other constituents of a good cutting tool steel are generally chromium unto 4% and small percentage of molybdenum.
  - Tungsten steel is now extensively used for cutting tools in connection with lathe works.
- **Silicon steel**
  - This is an alloy steel with silicon upto 4%.
  - It has high magnetic permeability and is widely used for cores of electromagnetic apparatus, transformers, etc.
  - Springs are made of silicon steel (upto 2% silican).
  - It has great strength, toughness and resilience.
  - Steel with 15% silicon is used for chemical plants as it has high corrosion resistance against acids.
- **Chromium steel**
  - In this alloy steel, chromium percentage is 1-2%.
  - Chromium increase the tensile strength and renders the metal hard and resistant to wear and abrasion.
  - It is used for making ball bearings, roller bearings, chisels, jaws of stone crushers, etc.
- **Stainless steel**
  - Contains 18-20% chromium and is highly corrosion resistant.
  - It is used for cutlery, machinery parts subject to high stresses, steam turbine blades, exhaust valves of internal combustion engines and other purposes.
  - Chromium is a hardening agent and steel containing 1% chromium is used for dies and ball race.
- **Nickel chromium steel**
  - This is the most important alloy steel for most engineering purpose.
  - Inclusion of nickel and chromium makes the steel exceptionally strong and resistant to wear, yet easily machine able.
  - The steel is used for parts subject to dynamic loads and shocks.

Non – Ferrous Metals

- The commonly used non-ferrous metals are aluminium (Al), antimony (Sb), bismuth copper (Cu), lead (Pb), nickel (Ni), tin (Sn), Zinc (Zn), manganese (Mn), chromium (Cr), and magnesium (Mg).
- **Aluminium**



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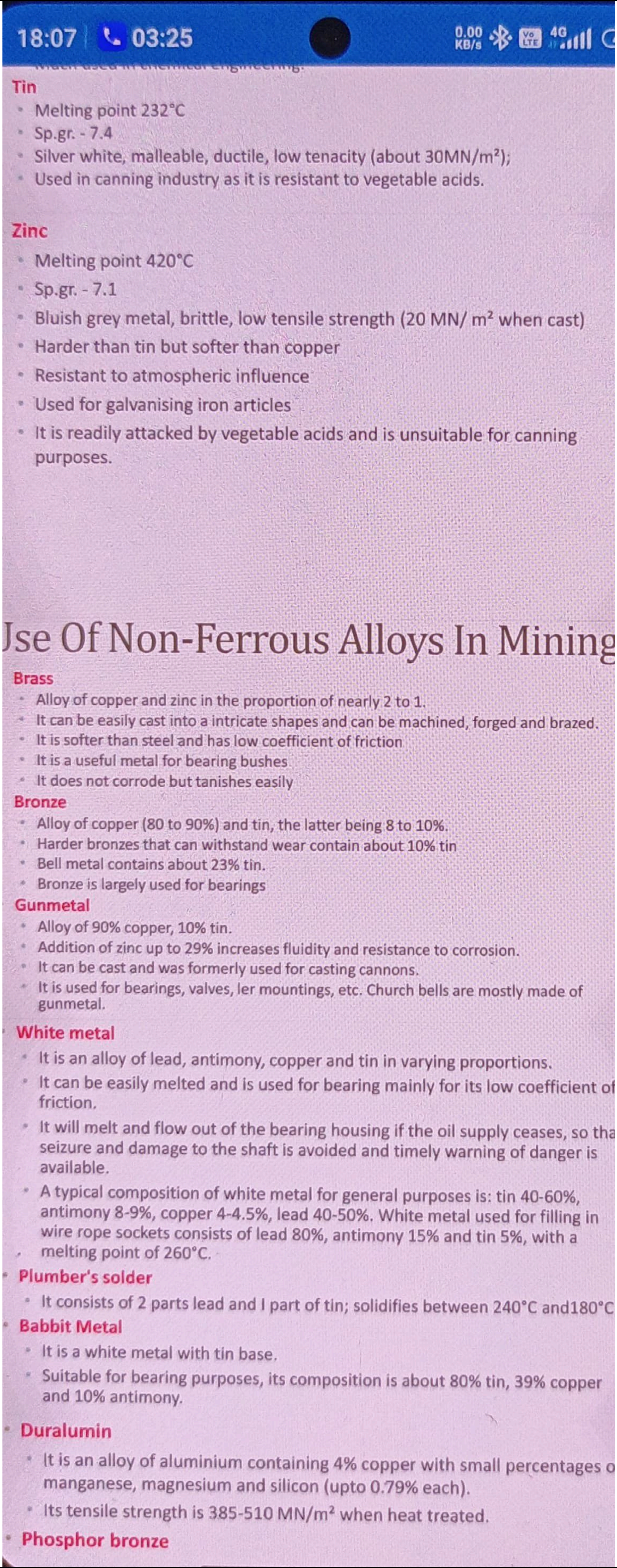
- **Aluminium**
  - It is manufactured from the raw material known as bauxite.
  - Melting point 658°C
  - Sp. gr. - 2.70
  - White in colour, good conductor of heat and electricity
  - Mechanically a weak metal.
- **Antimony**
  - Melting point 630° C
  - Sp. gr. - 6.7
  - bluish white metal, very brittle
  - used for hardening lead and tin alloys, e.g. white metals.
- **Bismuth**
  - Melting point 264°C
  - Sp. gr. - 9.82 white; brittle
  - used in some fusible alloys.
  - Bismuth expands on solidifying.
- **Copper**
  - Melting point 1050°C
  - Sp. gr. - 8.8
  - tough, soft, ductile, malleable with fine reddishcolour, very good conductor of electricity and heat and is used extensively in electrical industry.
  - After iron and steel, copper is probably the most important metal in engineering.
  - It can be cast but not easily machined.
  - It has high resistance to corrosion.
  - Copper may be cold-worked readily.
  - All the copper alloys may be annealed by heating the metal and cooling it rapidly in water, this being the exact opposite to that required in the case of steel.
- **Lead**
  - Melting point 327°C
  - Sp.gr. - 11.36
  - Very soft with bluish grey colour, malleable, ductile and tough, but has low tenacity, (less than 30 MN/m)
  - Used for making pipes, sheets, sheath in paper insulated electric cables, electrodes etc.
- **Nickel**
  - Melting point 1452°C
  - Sp. gr. - 8.8
  - White, malleble, ductile, tenacious, corrosion resistant
  - Much used in chemical engineering.
- **Tin**
  - Melting point 232°C
  - Sp.gr. - 7.4
  - Silver white, malleable, ductile, low tenacity (about 30MN/m^2);
  - Used in canning industry as it is resistant to vegetable acids.
- **Zinc**
  - Melting point 420°C
  - Sp.gr. - 7.1
  - Bluish grey metal, brittle, low tensile strength (20 MN/ m^2 when cast)
  - Harder than tin but softer than copper



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- Melting point 420°C
- Sp.gr. - 7.1
- Bluish grey metal, brittle, low tensile strength (20 MN/ m² when cast)
- Harder than tin but softer than copper
- Resistant to atmospheric influence
- Used for galvanising iron articles
- It is readily attacked by vegetable acids and is unsuitable for canning purposes.

Use Of Non-Ferrous Alloys In Mining

Brass

- Alloy of copper and zinc in the proportion of nearly 2 to 1.
- It can be easily cast into a intricate shapes and can be machined, forged and brazed.
- It is softer than steel and has low coefficient of friction
- It is a useful metal for bearing bushes
- It does not corrode but tanishes easily

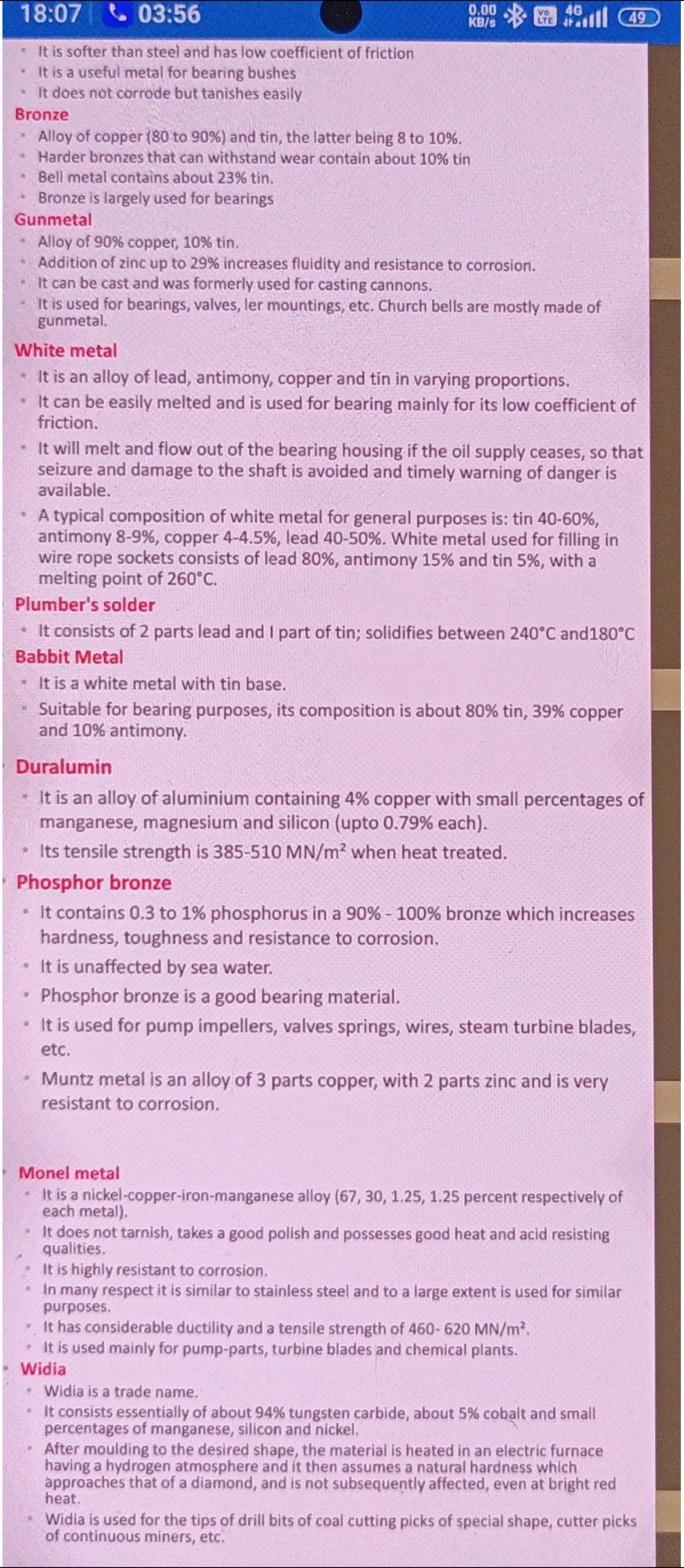
Bronze

- Alloy of copper (80 to 90%) and tin, the latter being 8 to 10%.
- Harder bronzes that can withstand wear contain about 10% tin
- Bell metal contains about 23% tin.
- Bronze is largely used for bearings

Gunmetal

- Alloy of 90% copper, 10% tin.
- Addition of zinc up to 29% increases fluidity and resistance to corrosion.
- It can be cast and was formerly used for casting cannons.
- It is used for bearings, valves, ler mountings, etc. Church bells are mostly made of gunmetal.

- **White metal**
  - It is an alloy of lead, antimony, copper and tin in varying proportions.
  - It can be easily melted and is used for bearing mainly for its low coefficient of friction.
  - It will melt and flow out of the bearing housing if the oil supply ceases, so tha seizure and damage to the shaft is avoided and timely warning of danger is available.
  - A typical composition of white metal for general purposes is: tin 40-60%, antimony 8-9%, copper 4-4.5%, lead 40-50%. White metal used for filling in wire rope sockets consists of lead 80%, antimony 15% and tin 5%, with a melting point of 260°C.
- **Plumber's solder**
  - It consists of 2 parts lead and I part of tin; solidifies between 240°C and180°C
- **Babbit Metal**
  - It is a white metal with tin base.
  - Suitable for bearing purposes, its composition is about 80% tin, 39% copper and 10% antimony.
- **Duralumin**
  - It is an alloy of aluminium containing 4% copper with small percentages o manganese, magnesium and silicon (upto 0.79% each).
  - Its tensile strength is 385-510 MN/m² when heat treated.
- **Phosphor bronze**



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Phosphor bronze

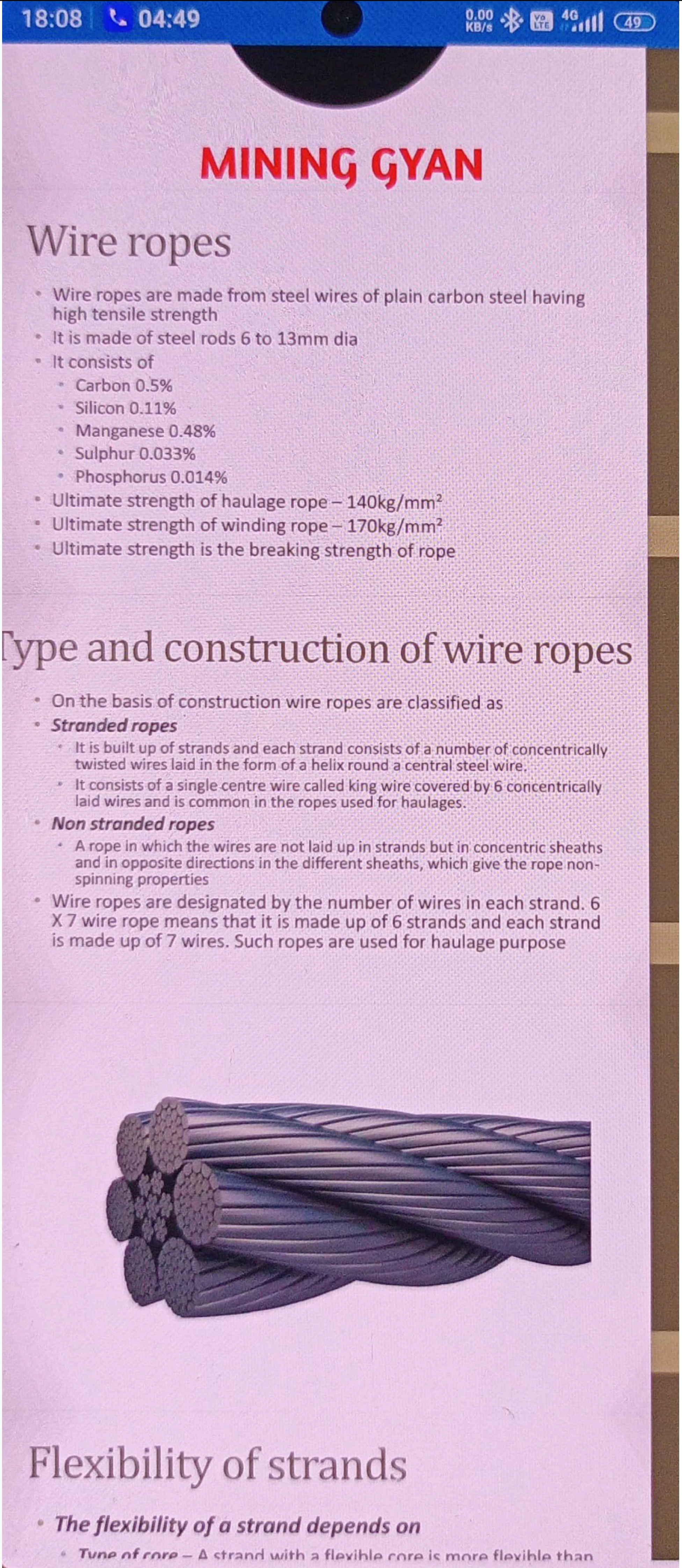
- It contains 0.3 to 1% phosphorus in a 90% - 100% bronze which increases hardness, toughness and resistance to corrosion.
- It is unaffected by sea water.
- Phosphor bronze is a good bearing material.
- It is used for pump impellers, valves springs, wires, steam turbine blades, etc.
- Muntz metal is an alloy of 3 parts copper, with 2 parts zinc and is very resistant to corrosion.

Monel metal

- It is a nickel-copper-iron-manganese alloy (67, 30, 1.25, 1.25 percent respectively of each metal).
- It does not tarnish, takes a good polish and possesses good heat and acid resisting qualities.
- It is highly resistant to corrosion.
- In many respect it is similar to stainless steel and to a large extent is used for similar purposes.
- It has considerable ductility and a tensile strength of 460- 620 MN/m^2.
- It is used mainly for pump-parts, turbine blades and chemical plants.

Widia

- Widia is a trade name.
- It consists essentially of about 94% tungsten carbide, about 5% cobalt and small percentages of manganese, silicon and nickel.
- After moulding to the desired shape, the material is heated in an electric furnace having a hydrogen atmosphere and it then assumes a natural hardness which approaches that of a diamond, and is not subsequently affected, even at bright red heat.
- Widia is used for the tips of drill bits of coal cutting picks of special shape, cutter picks of continuous miners, etc.



MINING GYAN

Wire ropes

- Wire ropes are made from steel wires of plain carbon steel having high tensile strength
- It is made of steel rods 6 to 13mm dia
- It consists of
  - Carbon 0.5%
  - Silicon 0.11%
  - Manganese 0.48%
  - Sulphur 0.033%
  - Phosphorus 0.014%
- Ultimate strength of haulage rope – 140kg/mm^2
- Ultimate strength of winding rope – 170kg/mm^2
- Ultimate strength is the breaking strength of rope

ype and construction of wire ropes

- On the basis of construction wire ropes are classified as
- ***Stranded ropes***
  - It is built up of strands and each strand consists of a number of concentrically twisted wires laid in the form of a helix round a central steel wire.
  - It consists of a single centre wire called king wire covered by 6 concentrically laid wires and is common in the ropes used for haulages.
- ***Non stranded ropes***
  - A rope in which the wires are not laid up in strands but in concentric sheaths and in opposite directions in the different sheaths, which give the rope non-spinning properties
- Wire ropes are designated by the number of wires in each strand. 6 X 7 wire rope means that it is made up of 6 strands and each strand is made up of 7 wires. Such ropes are used for haulage purpose

Flexibility of strands

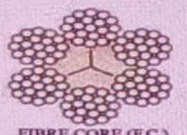
- ***The flexibility of a strand depends on***
  - *Type of core* – A strand with a flexible core is more flexible than

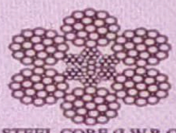
Flexibility of strands

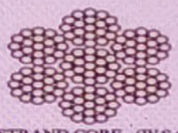
- ***The flexibility of a strand depends on***
  - *Type of core* – A strand with a flexible core is more flexible than one with steel wire at the centre
  - ***Thickness of Individual wires*** – Thinner the wires, more is the flexibility
  - ***Number of wires*** – Larger the number of wires more is the flexibility

Type of core

- **Fibre core –** It is used in winding
- **Steel strand core abbreviated as WMC –** It is used in Haulage
- **Independent wire rope core abbreviated as IWRC –** It is used in coal cutting machines

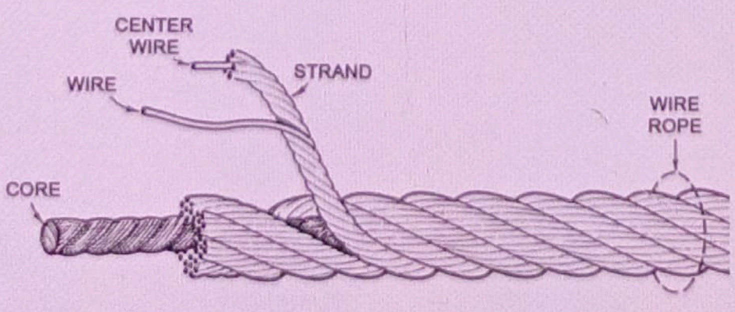

FIBRE CORE (F.C.)

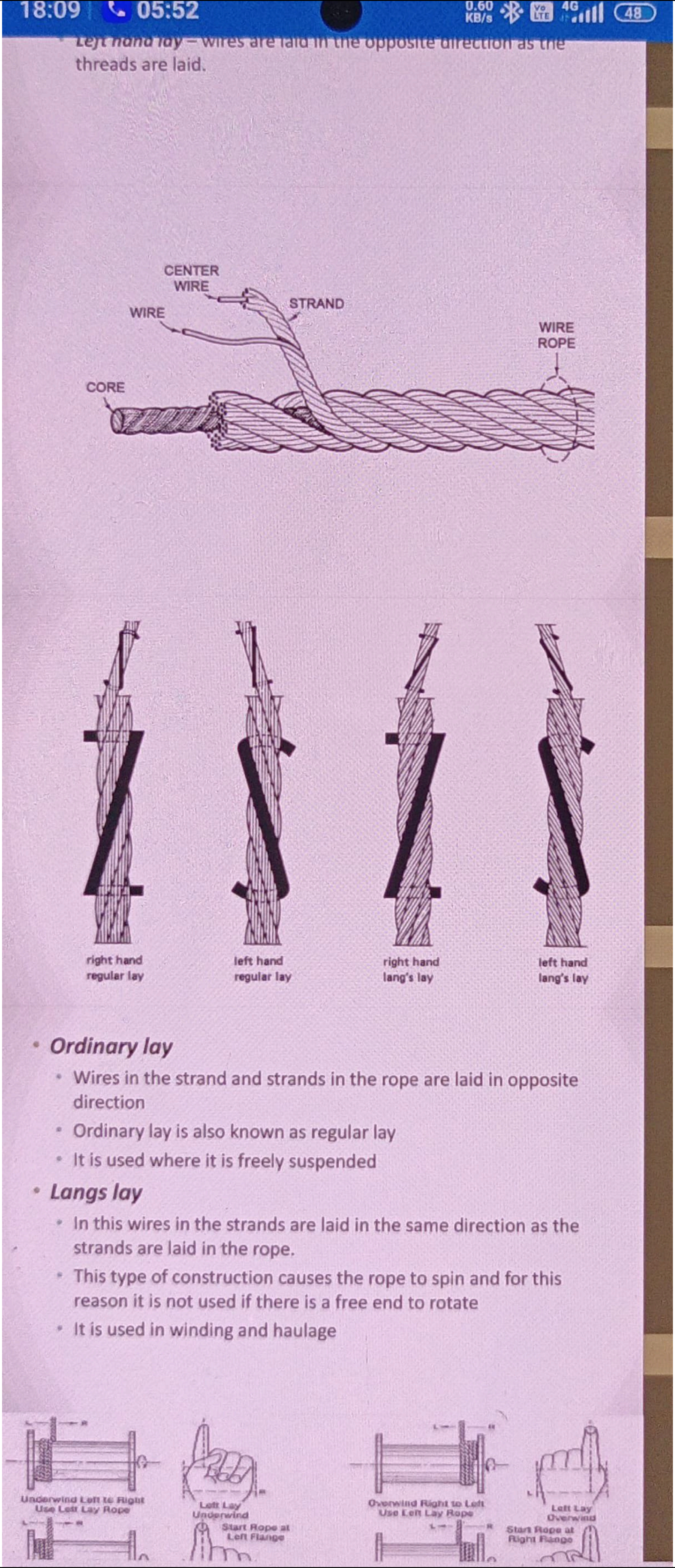

STEEL CORE (I.W.R.C.)


STRAND CORE (W.S.C.)

Wire rope lays

- It basically indicates the direction of laying of wires in the strand
- ***Types of lays***
  - ***Right hand lay*** – wires are laid in the same direction as the threads are laid.
  - ***Left hand lay*** – wires are laid in the opposite direction as the threads are laid.

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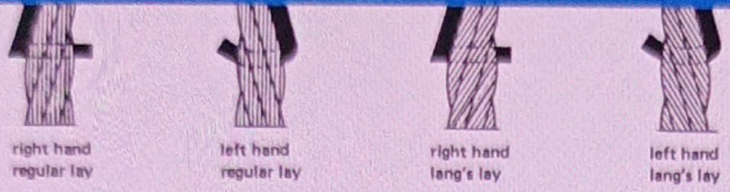
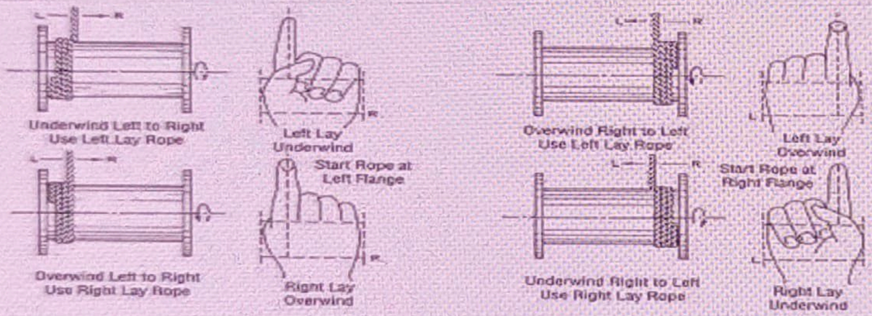
CENTER WIRE
WIRE
STRAND
WIRE ROPE
CORE
right hand regular lay
left hand regular lay
right hand lang's lay
left hand lang's lay
Underwind Left to Right Use Left Lay Rope
Left Lay Underwind
Start Rope at Left Flange
Overwind Right to Left Use Left Lay Rope
Left Lay Overwind
Start Rope at Right Flange

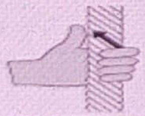
- ***Left hand lay*** – wires are laid in the opposite direction as the threads are laid.

- ***Ordinary lay***
  - Wires in the strand and strands in the rope are laid in opposite direction
  - Ordinary lay is also known as regular lay
  - It is used where it is freely suspended
- ***Langs lay***
  - In this wires in the strands are laid in the same direction as the strands are laid in the rope.
  - This type of construction causes the rope to spin and for this reason it is not used if there is a free end to rotate
  - It is used in winding and haulage

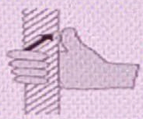

right hand
regular lay
left hand
regular lay
right hand
lang's lay
left hand
lang's lay

- ***Ordinary lay***
  - Wires in the strand and strands in the rope are laid in opposite direction
  - Ordinary lay is also known as regular lay
  - It is used where it is freely suspended
- ***Langs lay***
  - In this wires in the strands are laid in the same direction as the strands are laid in the rope.
  - This type of construction causes the rope to spin and for this reason it is not used if there is a free end to rotate
  - It is used in winding and haulage


L
R
Underwind Left to Right
Use Left Lay Rope
Left Lay
Underwind
Start Rope at
Left Flange
Overwind Left to Right
Use Right Lay Rope
Right Lay
Overwind
Overwind Right to Left
Use Left Lay Rope
Left Lay
Overwind
Start Rope at
Right Flange
Underwind Right to Left
Use Right Lay Rope
Right Lay
Underwind



Left hand lay of strands in the rope



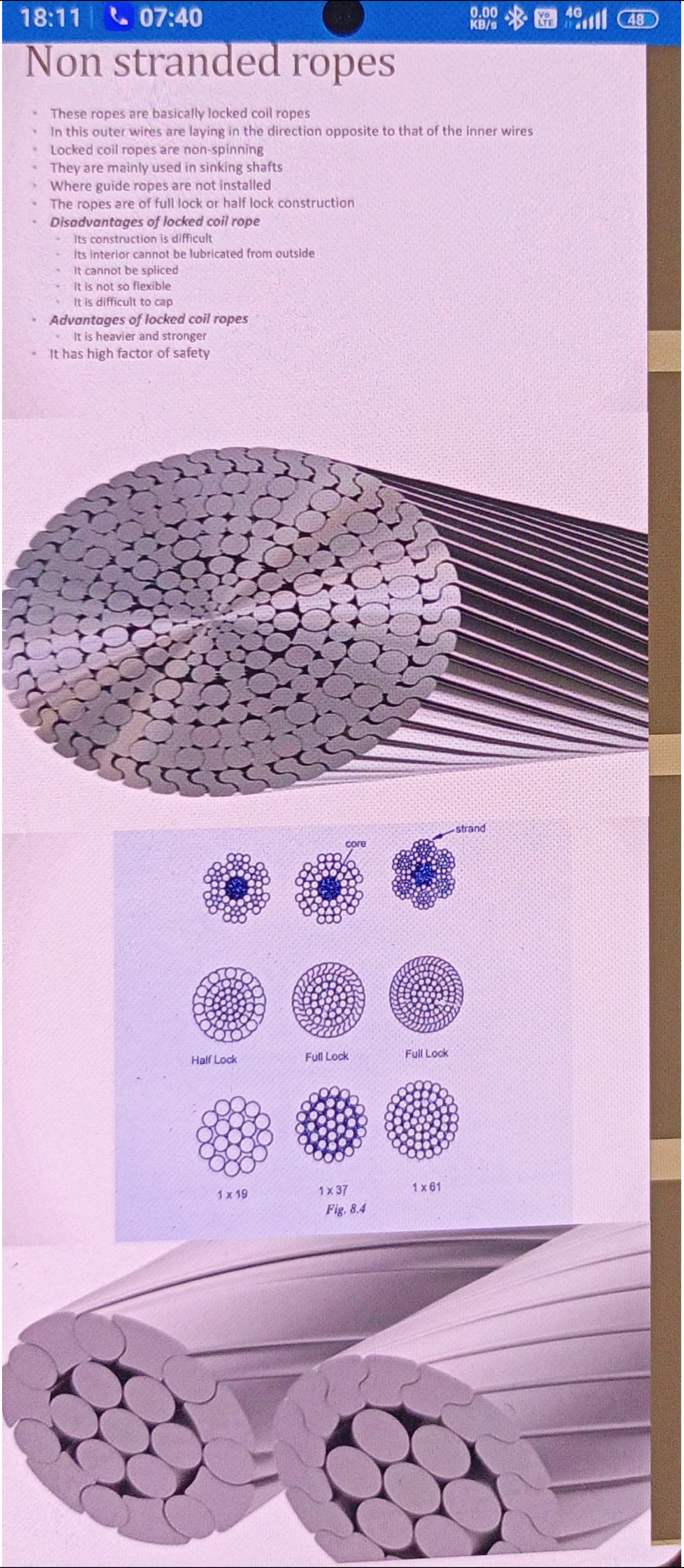
Right hand lay of strands in the rope

Preformed wire ropes

- It is a process of reshaping of wires and strands into the helical position so that the rope can be relieved from the internal stresses
- These ropes are easier to handle
- These type of ropes are used for haulage, winding, coal cutting machines, cranes, excavators etc.
- ***Advantages of preformed wire ropes***
  - Easy to handle
  - Longer life
  - Balanced load on strands
  - Broken wires lie flat
  - More easily spliced
  - Less liable to kink
  - More flexible

Non stranded ropes

- These ropes are basically locked coil ropes
- In this outer wires are laying in the direction opposite to that of the inner wires
- Locked coil ropes are non-spinning

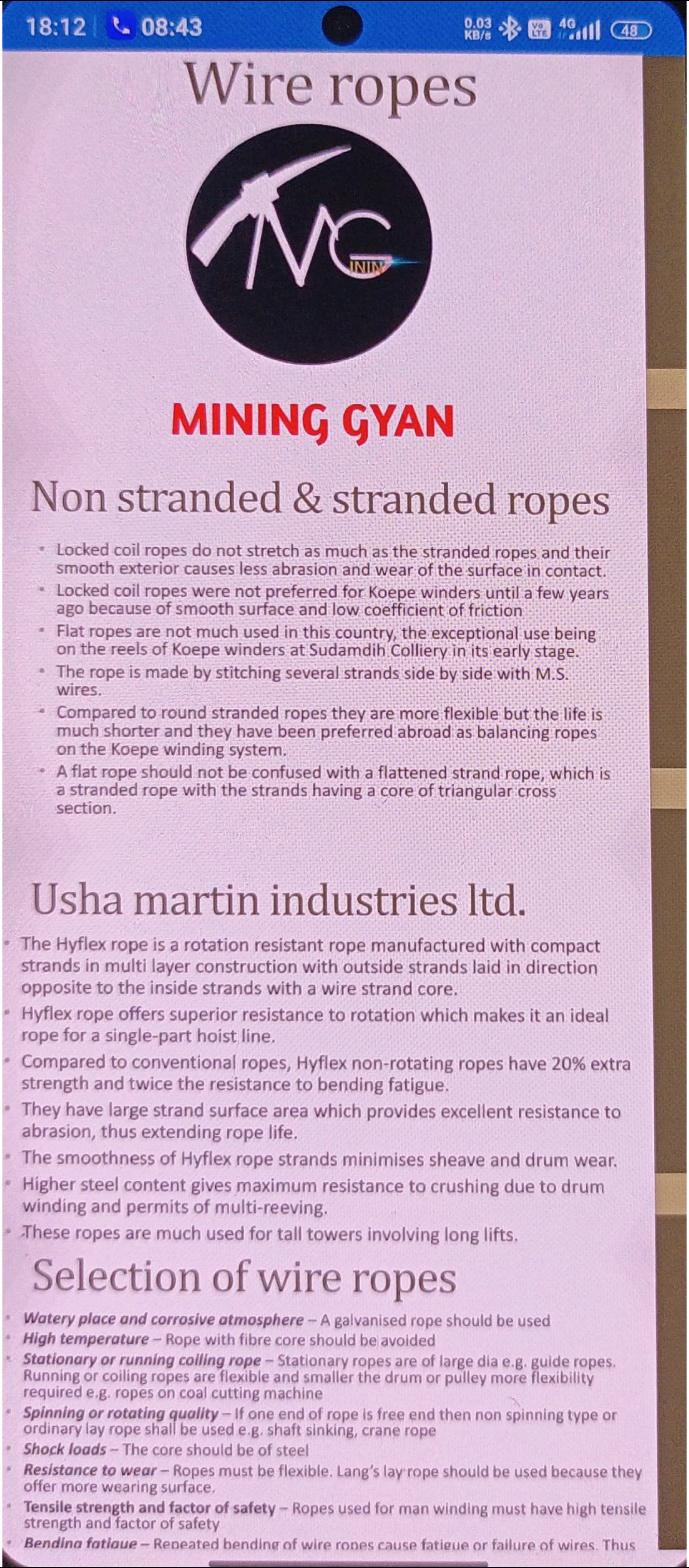

18:11
07:40
0.00 KB/s
48

Non stranded ropes

- These ropes are basically locked coil ropes
- In this outer wires are laying in the direction opposite to that of the inner wires
- Locked coil ropes are non-spinning
- They are mainly used in sinking shafts
- Where guide ropes are not installed
- The ropes are of full lock or half lock construction
- ***Disadvantages of locked coil rope***
  - Its construction is difficult
  - Its interior cannot be lubricated from outside
  - It cannot be spliced
  - It is not so flexible
  - It is difficult to cap
- ***Advantages of locked coil ropes***
  - It is heavier and stronger
- It has high factor of safety

core
strand
Half Lock
Full Lock
Full Lock
1 x 19
1 x 37
1 x 61

Fig. 8.4



Wire ropes

MINING GYAN

Non stranded & stranded ropes

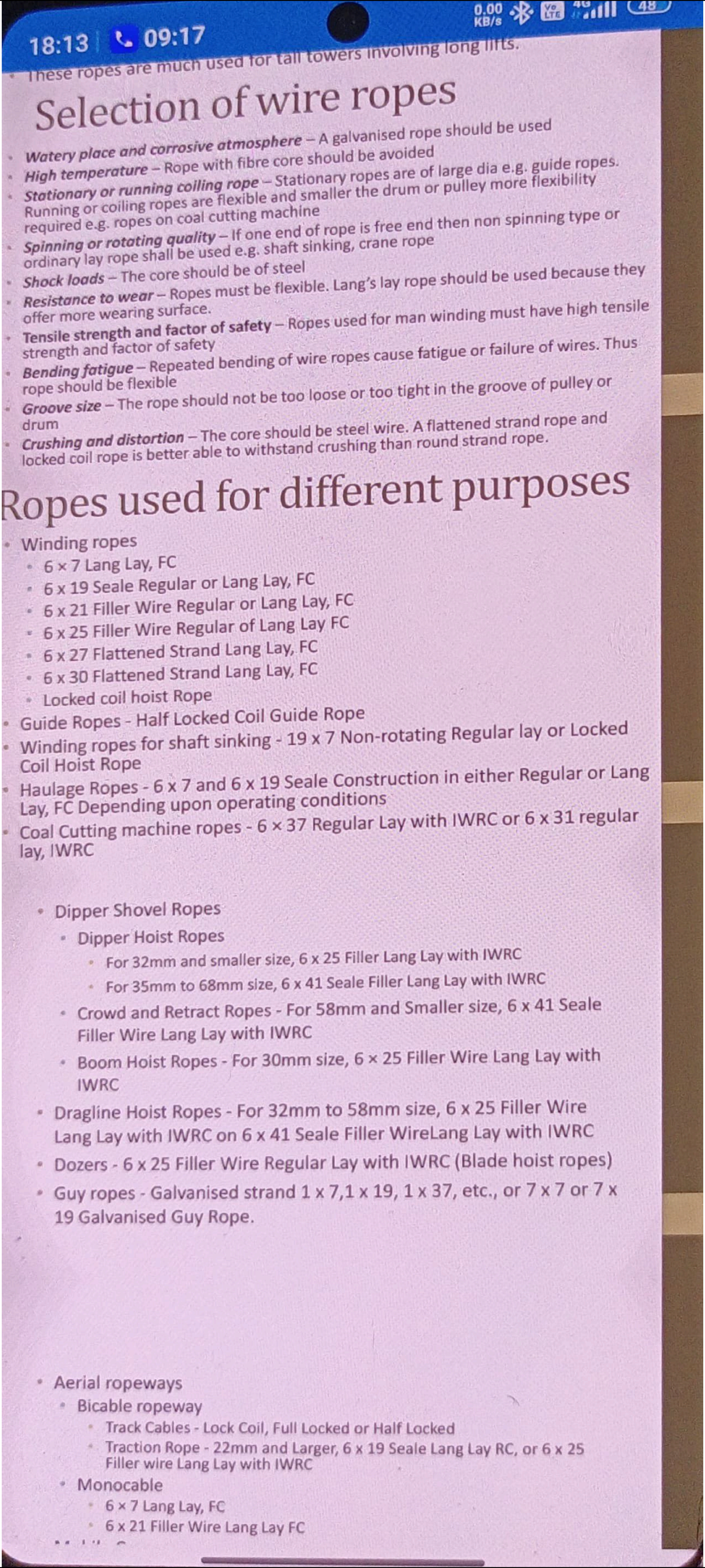
- Locked coil ropes do not stretch as much as the stranded ropes and their smooth exterior causes less abrasion and wear of the surface in contact.
- Locked coil ropes were not preferred for Koepe winders until a few years ago because of smooth surface and low coefficient of friction
- Flat ropes are not much used in this country, the exceptional use being on the reels of Koepe winders at Sudamdih Colliery in its early stage.
- The rope is made by stitching several strands side by side with M.S. wires.
- Compared to round stranded ropes they are more flexible but the life is much shorter and they have been preferred abroad as balancing ropes on the Koepe winding system.
- A flat rope should not be confused with a flattened strand rope, which is a stranded rope with the strands having a core of triangular cross section.

Usha martin industries ltd.

- The Hyflex rope is a rotation resistant rope manufactured with compact strands in multi layer construction with outside strands laid in direction opposite to the inside strands with a wire strand core.
- Hyflex rope offers superior resistance to rotation which makes it an ideal rope for a single-part hoist line.
- Compared to conventional ropes, Hyflex non-rotating ropes have 20% extra strength and twice the resistance to bending fatigue.
- They have large strand surface area which provides excellent resistance to abrasion, thus extending rope life.
- The smoothness of Hyflex rope strands minimises sheave and drum wear.
- Higher steel content gives maximum resistance to crushing due to drum winding and permits of multi-reeving.
- These ropes are much used for tall towers involving long lifts.

Selection of wire ropes

- ***Watery place and corrosive atmosphere*** – A galvanised rope should be used
- ***High temperature*** – Rope with fibre core should be avoided
- ***Stationary or running coiling rope*** – Stationary ropes are of large dia e.g. guide ropes. Running or coiling ropes are flexible and smaller the drum or pulley more flexibility required e.g. ropes on coal cutting machine
- ***Spinning or rotating quality*** – If one end of rope is free end then non spinning type or ordinary lay rope shall be used e.g. shaft sinking, crane rope
- ***Shock loads*** – The core should be of steel
- ***Resistance to wear*** – Ropes must be flexible. Lang's lay rope should be used because they offer more wearing surface.
- **Tensile strength and factor of safety** – Ropes used for man winding must have high tensile strength and factor of safety
- ***Bending fatigue*** – Repeated bending of wire ropes cause fatigue or failure of wires. Thus



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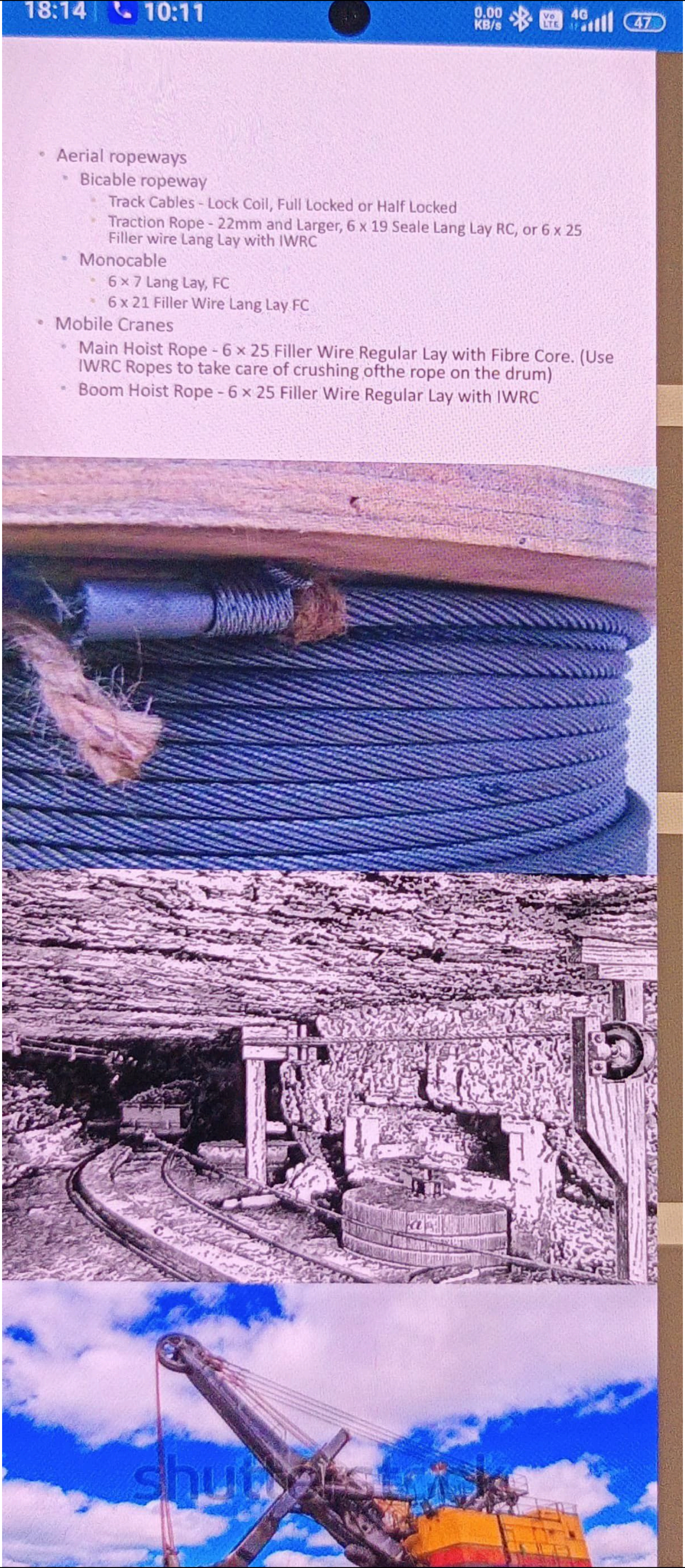
- ***Bending fatigue*** – Repeated bending of wire ropes cause fatigue or failure of wires. Thus rope should be flexible
- ***Groove size*** – The rope should not be too loose or too tight in the groove of pulley or drum
- ***Crushing and distortion*** – The core should be steel wire. A flattened strand rope and locked coil rope is better able to withstand crushing than round strand rope.

Ropes used for different purposes

- Winding ropes
  - 6 × 7 Lang Lay, FC
  - 6 x 19 Seale Regular or Lang Lay, FC
  - 6 x 21 Filler Wire Regular or Lang Lay, FC
  - 6 x 25 Filler Wire Regular of Lang Lay FC
  - 6 x 27 Flattened Strand Lang Lay, FC
  - 6 x 30 Flattened Strand Lang Lay, FC
  - Locked coil hoist Rope
- Guide Ropes - Half Locked Coil Guide Rope
- Winding ropes for shaft sinking - 19 x 7 Non-rotating Regular lay or Locked Coil Hoist Rope
- Haulage Ropes - 6 x 7 and 6 x 19 Seale Construction in either Regular or Lang Lay, FC Depending upon operating conditions
- Coal Cutting machine ropes - 6 × 37 Regular Lay with IWRC or 6 x 31 regular lay, IWRC

- Dipper Shovel Ropes
  - Dipper Hoist Ropes
    - For 32mm and smaller size, 6 x 25 Filler Lang Lay with IWRC
    - For 35mm to 68mm size, 6 x 41 Seale Filler Lang Lay with IWRC
  - Crowd and Retract Ropes - For 58mm and Smaller size, 6 x 41 Seale Filler Wire Lang Lay with IWRC
  - Boom Hoist Ropes - For 30mm size, 6 × 25 Filler Wire Lang Lay with IWRC
- Dragline Hoist Ropes - For 32mm to 58mm size, 6 x 25 Filler Wire Lang Lay with IWRC on 6 x 41 Seale Filler WireLang Lay with IWRC
- Dozers - 6 x 25 Filler Wire Regular Lay with IWRC (Blade hoist ropes)
- Guy ropes - Galvanised strand 1 x 7,1 x 19, 1 x 37, etc., or 7 x 7 or 7 x 19 Galvanised Guy Rope.

- Aerial ropeways
  - Bicable ropeway
    - Track Cables - Lock Coil, Full Locked or Half Locked
    - Traction Rope - 22mm and Larger, 6 x 19 Seale Lang Lay RC, or 6 x 25 Filler wire Lang Lay with IWRC
  - Monocable
    - 6 × 7 Lang Lay, FC
    - 6 x 21 Filler Wire Lang Lay FC



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    - Track Cables - Lock Coil, Full Locked or Half Locked
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  - Monocable
    - 6 × 7 Lang Lay, FC
    - 6 x 21 Filler Wire Lang Lay FC
- Mobile Cranes
  - Main Hoist Rope - 6 × 25 Filler Wire Regular Lay with Fibre Core. (Use IWRC Ropes to take care of crushing ofthe rope on the drum)
  - Boom Hoist Rope - 6 × 25 Filler Wire Regular Lay with IWRC

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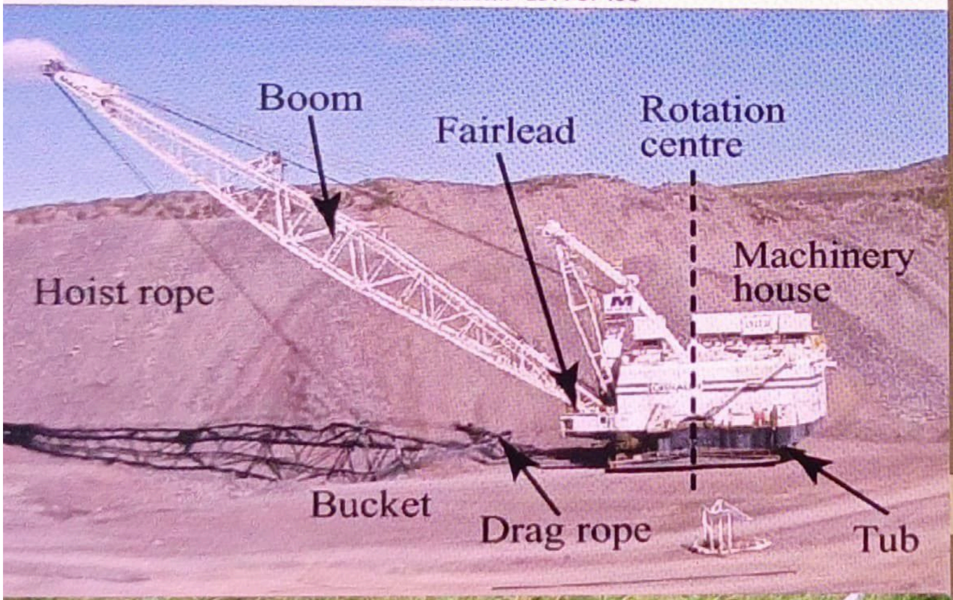
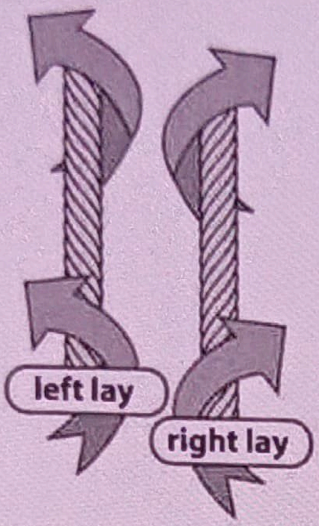
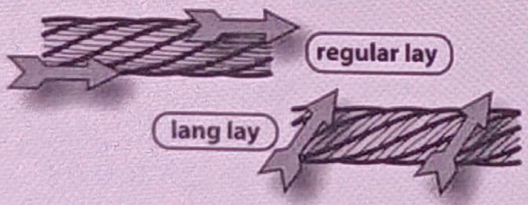
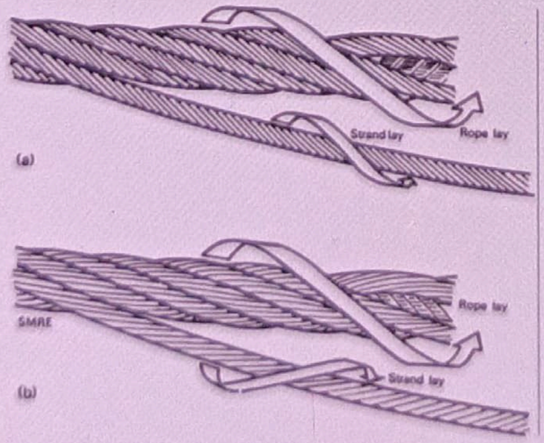
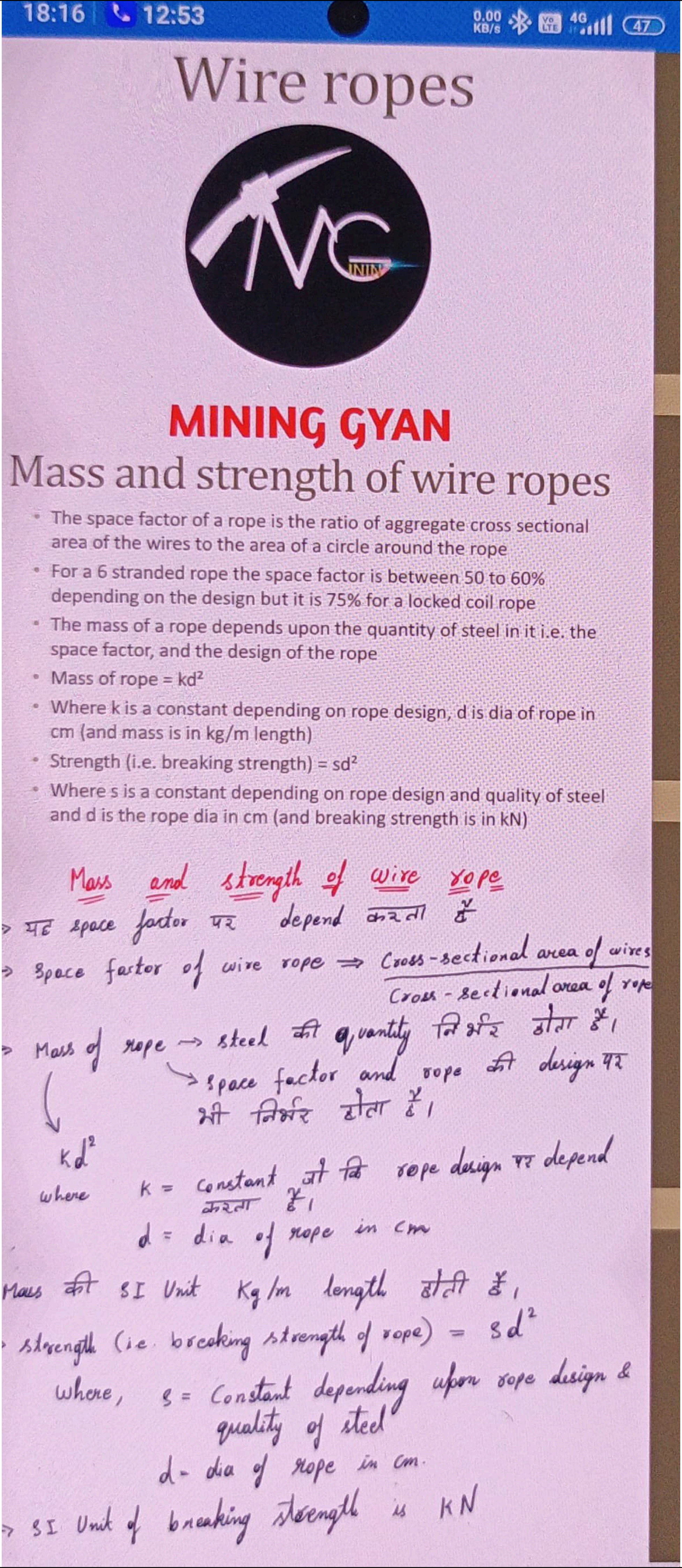

Boom
Fairlead
Rotation centre
Hoist rope
Machinery house
Bucket
Drag rope
Tub

18:15
11:47
wirerope-sling.com


left lay
right lay


regular lay
lang lay


Strand lay
Rope lay
(a)
SMRE
Rope lay
Strand lay
(b)



Wire ropes

MINING GYAN

Mass and strength of wire ropes

- The space factor of a rope is the ratio of aggregate cross sectional area of the wires to the area of a circle around the rope
- For a 6 stranded rope the space factor is between 50 to 60% depending on the design but it is 75% for a locked coil rope
- The mass of a rope depends upon the quantity of steel in it i.e. the space factor, and the design of the rope
- Mass of rope = kd^2
- Where k is a constant depending on rope design, d is dia of rope in cm (and mass is in kg/m length)
- Strength (i.e. breaking strength) = sd^2
- Where s is a constant depending on rope design and quality of steel and d is the rope dia in cm (and breaking strength is in kN)

Mass and strength of wire rope

→ यह space factor पर depend करता है

→ Space factor of wire rope $\Rightarrow \dfrac{\text{Cross-sectional area of wires}}{\text{Cross-sectional area of rope}}$

→ Mass of rope → steel की quantity निर्भर होता है।
→ space factor and rope की design पर भी निर्भर होता है।
↓
kd^2

where k = constant जो कि rope design पर depend करता है।
d = dia of rope in cm

Mass की SI Unit Kg/m length होती है।

→ strength (i.e. breaking strength of rope) = sd^2

where, s = Constant depending upon rope design & quality of steel
d = dia of rope in cm.

→ SI Unit of breaking strength is KN

where, s = Constant depending upon rope design &
quality of steel
d = dia of rope in cm.

→ SI Unit of breaking strength is kN

- If the steel has a breaking strength of 1570MN/m² (nearly 160kg/mm² which is the usual value), the values of k and s for purposes of the above formulae are generally as follows, is d is in cm, m (mass) is in kg/m and the breaking strength is in kN

Type of rope	K	S
Round strand with fire core	0.36	52
Round strand with wire core	0.40	56
Flattened strand with fibre core	0.41	55
Flattened strand with wire core	0.45	58
Locked coil	0.56	85

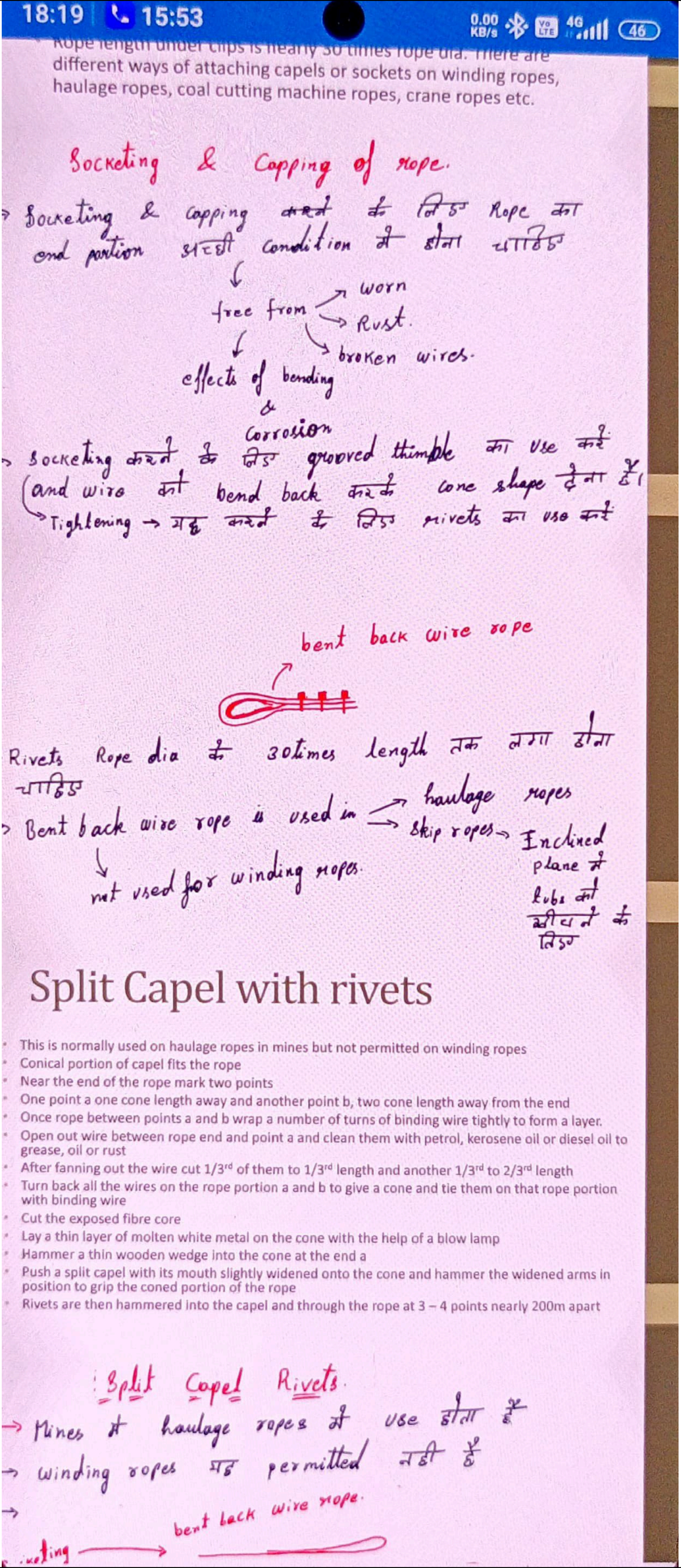
Socketing and capping a rope

- The end of a rope where the load is to be attached should be a good portion of the rope, free from worn, rusted bent or broken wires and free from effects of bending and corrosion.
- The simplest way to make the rope and suitable for attachment of load is to use a grooved thimble and bend back the rope end on it and part of the rope before finally tightening 4 – 6 rope clips of intervals on it
- Such attachment is permissible for haulage ropes and skip ropes hoisting on inclined planes but not permitted for winding ropes
- Rope length under clips is nearly 30 times rope dia. There are different ways of attaching capels or sockets on winding ropes, haulage ropes, coal cutting machine ropes, crane ropes etc.

Socketing & Capping of rope.

→ Socketing & capping करने के लिए Rope का end portion अच्छी condition में होना चाहिए
↓
free from → worn
→ Rust.
→ broken wires.
↓
effects of bending & corrosion

→ socketing करने के लिए grooved thimble का use करें cone shape देना है।
(and wire को bend back करके
→ Tightening → यह करने के लिए rivets का use करें



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↓

free from → worn, → Rust. → broken wires.

↓

effects of bending & corrosion

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Rivets Rope dia के 30times length तक लगा होना चाहिए

→ Bent back wire rope is used in → haulage ropes → skip ropes → Inclined plane में tubs को खींचने के लिए

↓ not used for winding ropes.

Split Capel with rivets

- This is normally used on haulage ropes in mines but not permitted on winding ropes
- Conical portion of capel fits the rope
- Near the end of the rope mark two points
- One point a one cone length away and another point b, two cone length away from the end
- Once rope between points a and b wrap a number of turns of binding wire tightly to form a layer.
- Open out wire between rope end and point a and clean them with petrol, kerosene oil or diesel oil to grease, oil or rust
- After fanning out the wire cut 1/3rd of them to 1/3rd length and another 1/3rd to 2/3rd length
- Turn back all the wires on the rope portion a and b to give a cone and tie them on that rope portion with binding wire
- Cut the exposed fibre core
- Lay a thin layer of molten white metal on the cone with the help of a blow lamp
- Hammer a thin wooden wedge into the cone at the end a
- Push a split capel with its mouth slightly widened onto the cone and hammer the widened arms in position to grip the coned portion of the rope
- Rivets are then hammered into the capel and through the rope at 3 – 4 points nearly 200m apart

Split Capel Rivets.

→ Mines में haulage ropes में use होता है

→ winding ropes पर permitted नहीं है

→

Split Capel Rivets.

→ Mines में haulage ropes में use होता है

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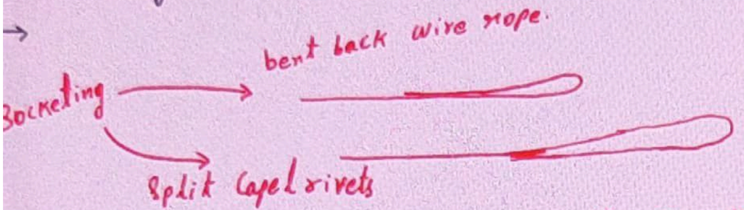
→


Socketing
bent back wire rope.
Split Capel rivets

→ wire rope के हर एक wire को निकालेंगे and इसे साफ करेंगे

for cleaning → Petrol, Kerosene, diesel

Total wires में से 1/3rd wires को 1/3rd length तक cut कर देंगे

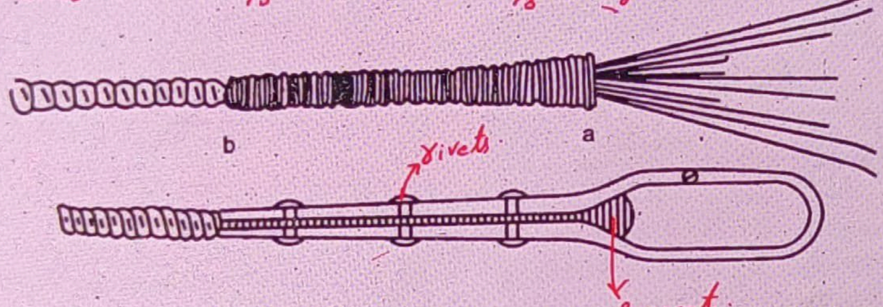
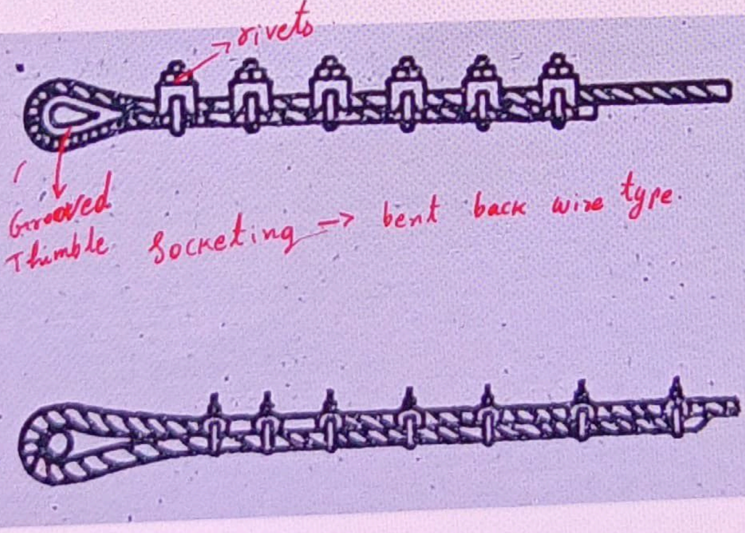

b
a
rivets
socket.

Fig. 8.7

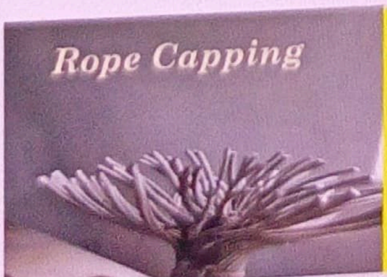
Top : Cutting wires to make a cone

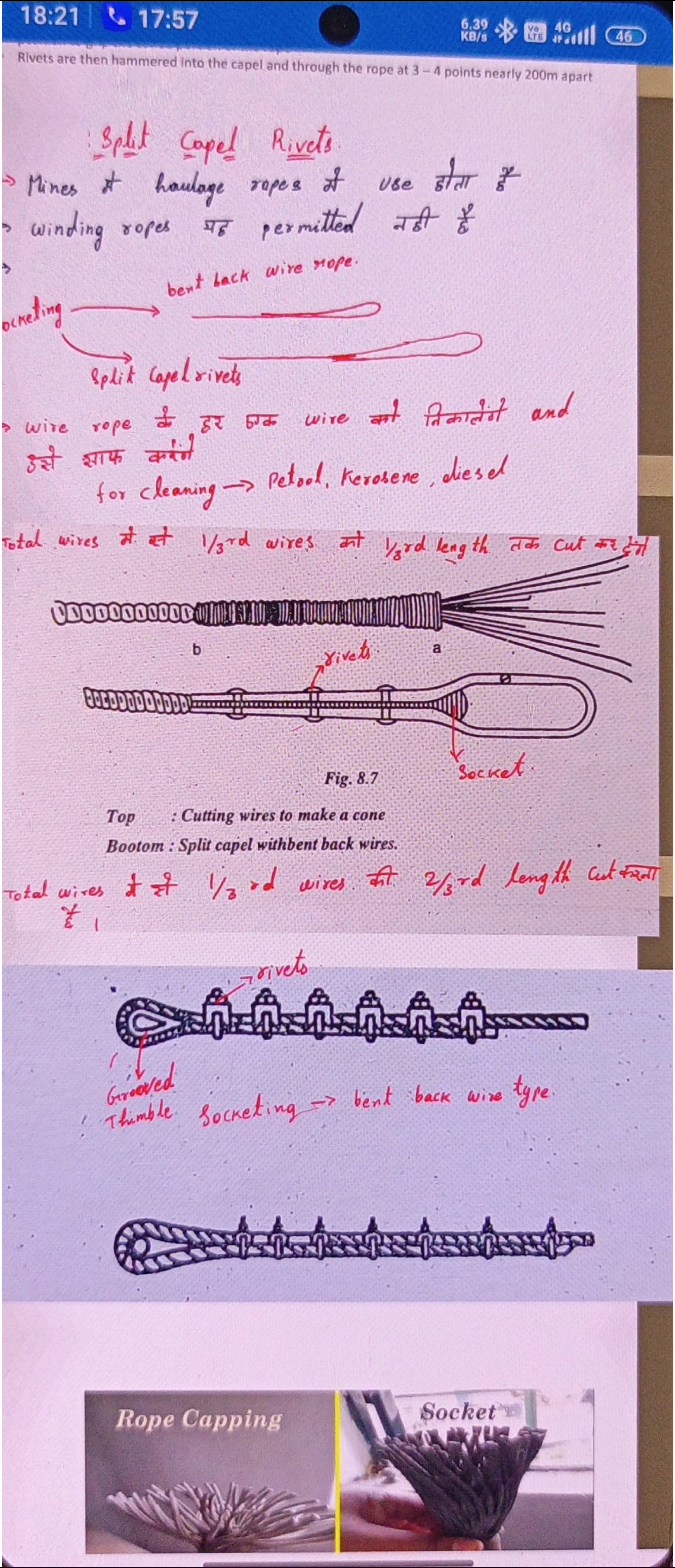
Bootom : Split capel withbent back wires.

Total wires में से 1/3rd wires की 2/3rd length cut करना है।


rivets
Grooved Thimble

Socketing → bent back wire type.


Rope Capping


18:21
17:57
6.39 KB/s
4G
46
b
a
rivets
Socket
rivets
Grooved Thimble
Rope Capping
Socket

Rivets are then hammered into the capel and through the rope at 3 – 4 points nearly 200m apart

Split Capel Rivets

→ Mines में haulage ropes में use होता है
→ winding ropes यह permitted नहीं है
→

ocketing → bent back wire rope.
→ Split capel rivets

→ wire rope के हर एक wire को निकालेंगे and उसे साफ करेंगे
for cleaning → Petrol, Kerosene, diesel

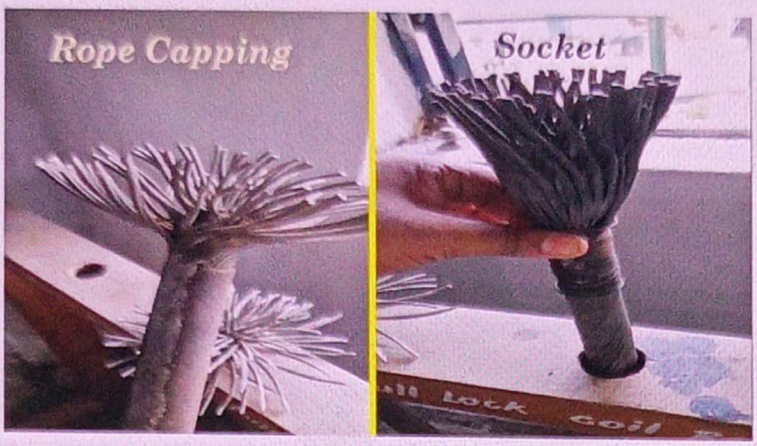
Total wires में से 1/3rd wires को 1/3rd length तक cut करेंगे

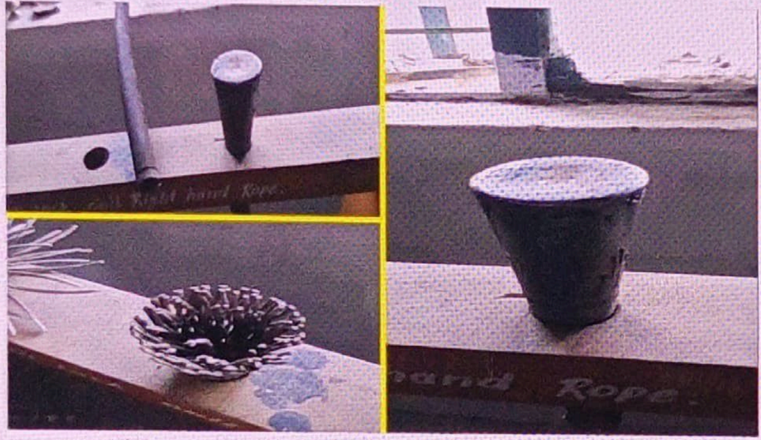
Fig. 8.7

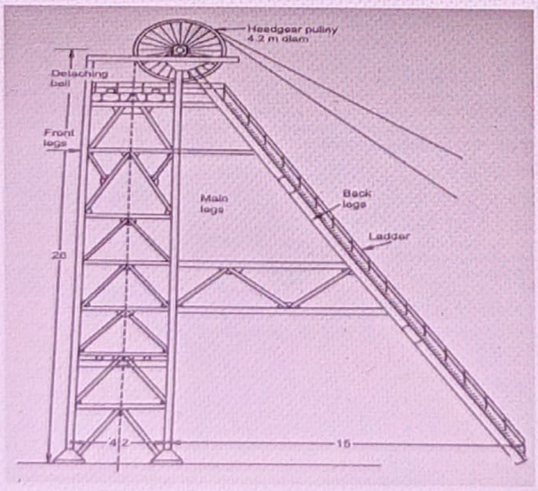
Top : Cutting wires to make a cone
Bootom : Split capel withbent back wires.

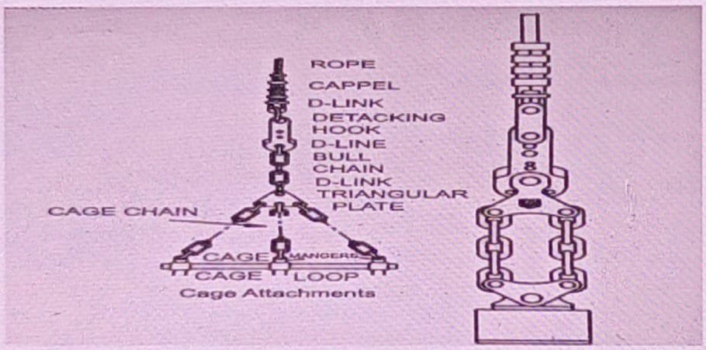
Total wires में से 1/3rd wires की 2/3rd length cut करता है।

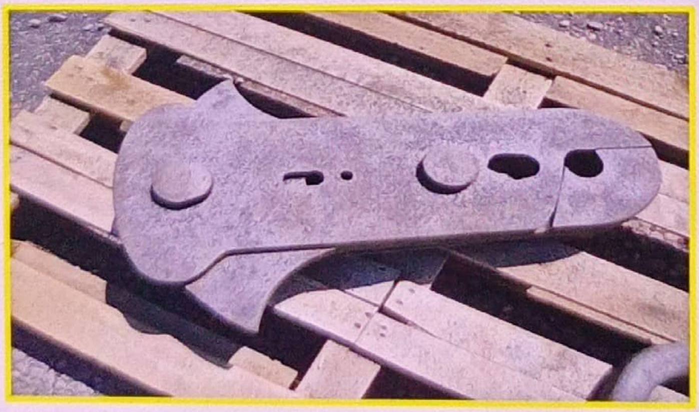
Socketing → bent back wire type.

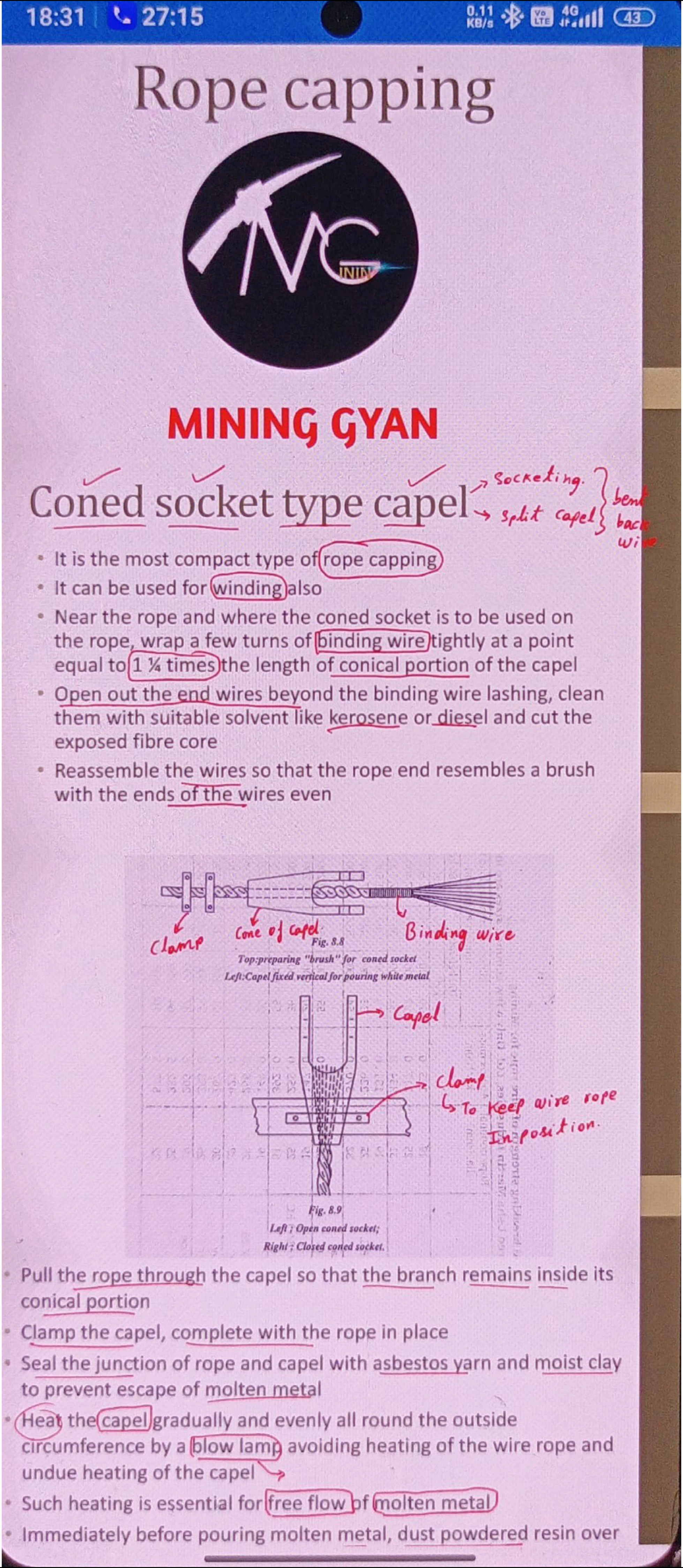

Rope Capping
Socket
ll lock Coil


Coil Right hand Rope
hand Rope


Headgear pulley
4.2 m diam
Detaching bell
Front legs
Main legs
Back legs
Ladder
20
4.2
15


ROPE
CAPPEL
D-LINK
DETACKING HOOK
D-LINE
BULL CHAIN
D-LINK
TRIANGULAR PLATE
CAGE CHAIN
CAGE HANGERS
CAGE LOOP
Cage Attachments





Rope capping

MINING GYAN

Coned socket type capel

→ Socketing.
→ split capel
bent back wire

- It is the most compact type of rope capping
- It can be used for winding also
- Near the rope and where the coned socket is to be used on the rope, wrap a few turns of binding wire tightly at a point equal to 1 ¼ times the length of conical portion of the capel
- Open out the end wires beyond the binding wire lashing, clean them with suitable solvent like kerosene or diesel and cut the exposed fibre core
- Reassemble the wires so that the rope end resembles a brush with the ends of the wires even

Fig. 8.8

Top:preparing "brush" for coned socket

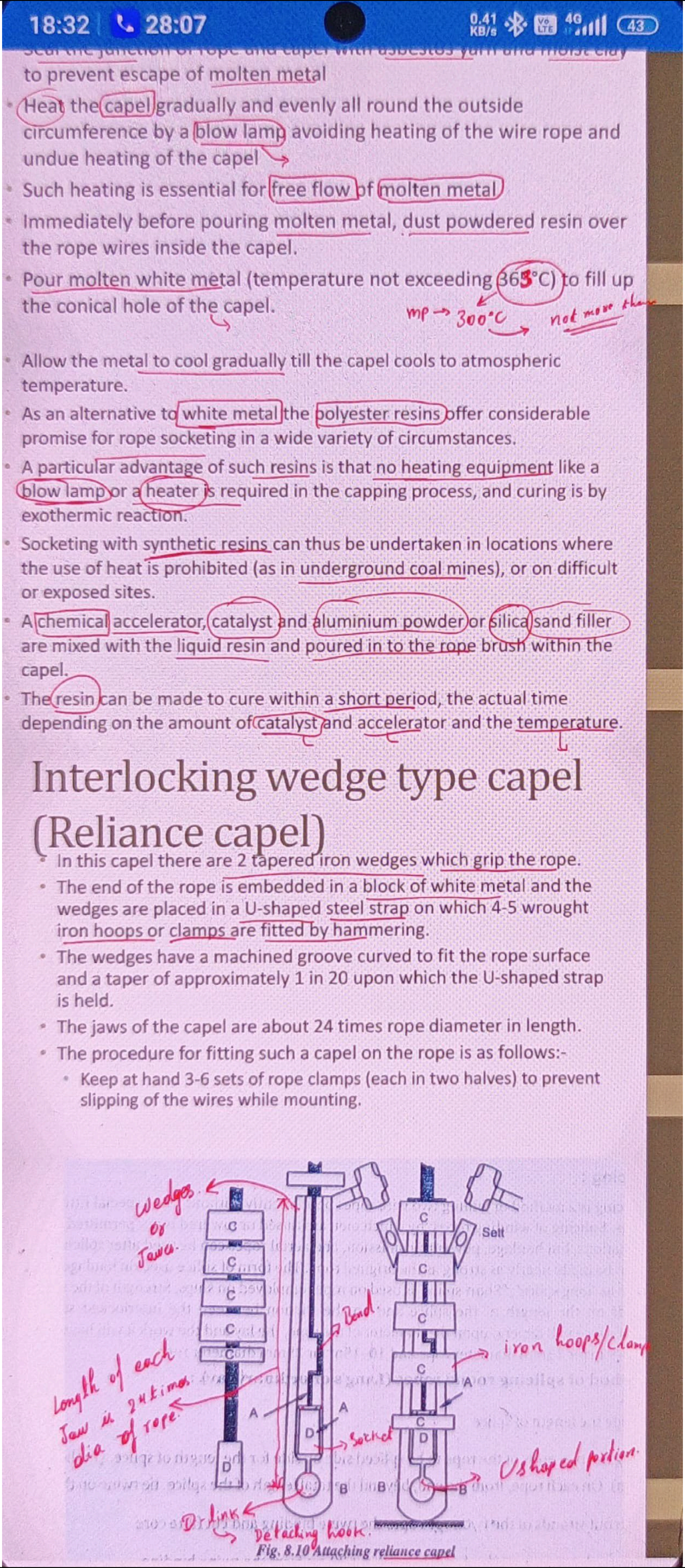
Left:Capel fixed vertical for pouring white metal

Fig. 8.9

Left ; Open coned socket;

Right ; Closed coned socket.

- Pull the rope through the capel so that the branch remains inside its conical portion
- Clamp the capel, complete with the rope in place
- Seal the junction of rope and capel with asbestos yarn and moist clay to prevent escape of molten metal
- Heat the capel gradually and evenly all round the outside circumference by a blow lamp avoiding heating of the wire rope and undue heating of the capel
- Such heating is essential for free flow of molten metal
- Immediately before pouring molten metal, dust powdered resin over



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- Heat the capel gradually and evenly all round the outside circumference by a blow lamp avoiding heating of the wire rope and undue heating of the capel
- Such heating is essential for free flow of molten metal
- Immediately before pouring molten metal, dust powdered resin over the rope wires inside the capel.
- Pour molten white metal (temperature not exceeding 365°C) to fill up the conical hole of the capel.

mp → 300°C → not more than

- Allow the metal to cool gradually till the capel cools to atmospheric temperature.
- As an alternative to white metal the polyester resins offer considerable promise for rope socketing in a wide variety of circumstances.
- A particular advantage of such resins is that no heating equipment like a blow lamp or a heater is required in the capping process, and curing is by exothermic reaction.
- Socketing with synthetic resins can thus be undertaken in locations where the use of heat is prohibited (as in underground coal mines), or on difficult or exposed sites.
- A chemical accelerator, catalyst and aluminium powder or silica sand filler are mixed with the liquid resin and poured in to the rope brush within the capel.
- The resin can be made to cure within a short period, the actual time depending on the amount of catalyst and accelerator and the temperature.

Interlocking wedge type capel (Reliance capel)

- In this capel there are 2 tapered iron wedges which grip the rope.
- The end of the rope is embedded in a block of white metal and the wedges are placed in a U-shaped steel strap on which 4-5 wrought iron hoops or clamps are fitted by hammering.
- The wedges have a machined groove curved to fit the rope surface and a taper of approximately 1 in 20 upon which the U-shaped strap is held.
- The jaws of the capel are about 24 times rope diameter in length.
- The procedure for fitting such a capel on the rope is as follows:-
  - Keep at hand 3-6 sets of rope clamps (each in two halves) to prevent slipping of the wires while mounting.

Fig. 8.10 Attaching reliance capel

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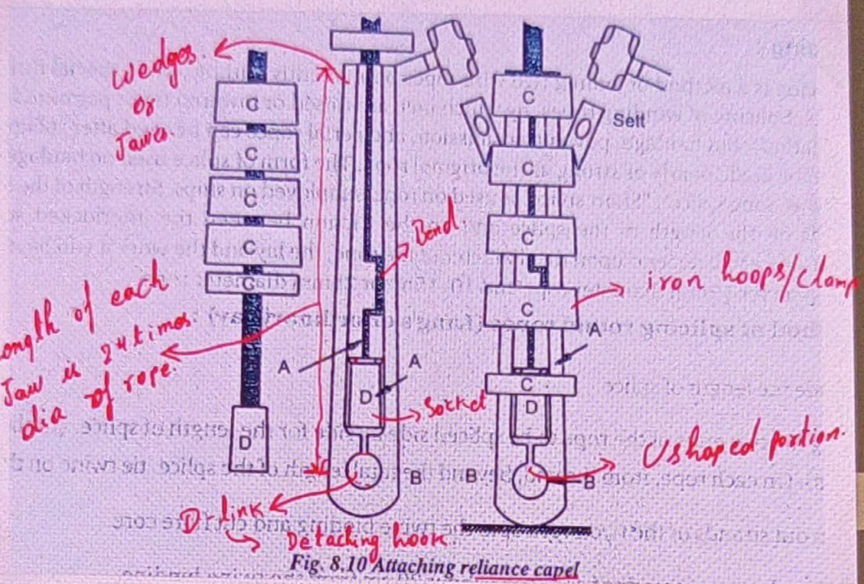

Fig. 8.10 Attaching reliance capel

- Six clamps should be used for locked coil ropes.
- Near the end of the rope, at a distance equal to the tapered length of the capel, lash a layers of binding wire on the rope.
- Similarly, lash a layer of binding wire on the rope at about 200mm from the end.
- Thread the wrought iron hoops, C, on the rope in the correct order which they will occupy on the capel.
- Then thread the metallic cone D on the rope.
- Fix a set of clamps to the rope portion which will, at the end of the operation, remain inside the wedges.
- Open up the end wires for a length equal to the length of cone D, clean them, cut out the exposed fibre core, if any, and slide the metallic cone on the cleaned wires made as brush.

- Warm up the cone with a blow lamp and pour white metal into the core as described in (b) for coned socket type capel so that when the metal solidifies, the wires, the metal, and the cone become one solid mass.
- After removing the rope clamps and the remaining binding wires clean the rope for a length slightly in excess of the tapered - wedges length.
- Make sure that the wedge grooves are completely free from lubricant.
- Place the interlocking wedges on the rope and the whole assembly into the U-shaped strap after greasing the back of the wedges.
- Slide the wrought iron hoops on to the U-strap and hammer them lightly in position.
- The capel is placed on a hard floor and the hoops are hammered hard with a shaped set in conjunction with a sledge hammer.
- The end cone D should not touch the interlocking wedges and when the capel will be in use the slight gap between the wedges and the cone will indicate that the rope is not sliding up the capel.

Rope splicing

- Splicing is a method of joining two wire ropes permanently without using special fittings or attachments.
- Splicing of winding ropes, by which men are raised or lowered is not permitted under mining regulations, but haulage, power transmission, and

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- Splicing of winding ropes, by which men are raised or lowered is not permitted under mining regulations, but haulage, power transmission, and aerial ropes can be used after splicing and the splice can be made nearly as strong as the original rope.
- The form of splice used on haulage ropes is that known as "long splice", "Short splice" is used on ropes employed on ships.
- Strength of the spliced rope depends on the length of the splice and on the friction between the interlocked strands.
- The length of splice will depend upon the diameter of the rope, the lay and the work it will have to do.
- It is nearly 6-9 m for 13mm diameter rope and 10-15m for 25mm diameter rope.

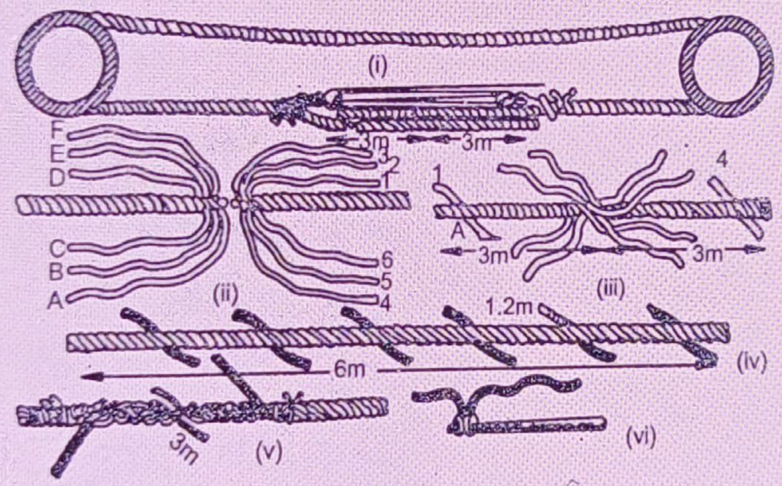

Fig. 8.11 Splicing a wire rope.

Long splicing of flattened strand ropes

- Up to the stage of tucking, the procedure is the same as for round strand ropes.
- While the running in of the strands should present no difficulties in ensuring that the flats of the triangular strand from the circumference of the rope, it may be found that the corners tend to occupy this position.
- In such cases the strand should be clamped and then turned to the desired position.
- At the tucking in stage there are slight modifications:- As the core in a flattened strand rope is smaller than in a round strand rope of equal size, the tails should not be bound over their full 1.2m length which is to be run in.
- A short whipping is made on the end of the strands, merely to retain the wires in their stranded positions.

Care of wire ropes during storage and use

- Avoid the use of rope with fibre core, when the rope is subject to heat, fumes and extreme pressure
- Buy right construction of rope suitable for the job
- Corrosion can be delayed by using galvanised rope

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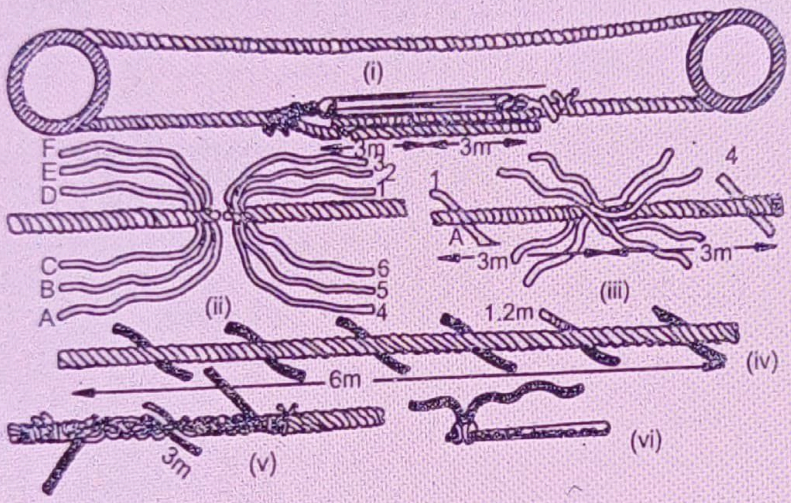

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Care of wire ropes during storage and use

- Avoid the use of rope with fibre core, when the rope is subject to heat, fumes and extreme pressure
- Buy right construction of rope suitable for the job
- Corrosion can be delayed by using galvanised rope.
- Don't load the rope beyond its safe working load
- Flexibility of rope should be suitable to the size of drums and pulleys, and diameter of rope to grooves
- Ensure that the rope is strongly seized before it is cut
- Grease the rope and cover properly before storing in a dry ventilated shed.
- Handle the rope carefully while transporting and uncoiling to avoid kinks.
- Inspect the rope periodically and lubricate with acid-free lubricant.
- Judge the safe life of the rope for the conditions under which it has to work and replace it in proper time

Winding

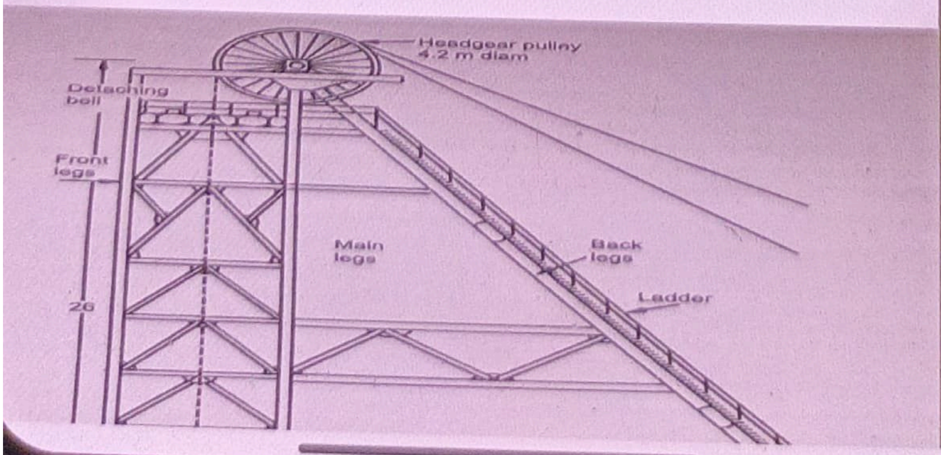
MINING GYAN

Winding Equipment's

- A tower like structure of steel or concrete called headgear
- Winding rope
- Attachment headgear between cage and rope such as cage chains, rope capel and distributing plate
- Headgear pulleys
- Winding drum
- Steam engine/electric motor and its controlling apparatus
- Arrangement for guiding the cage during its ascent and descent

Headgear

- The headgear is a steel or concrete frame work on the shaft mouth. Its purpose is to :-
  - To support
    - Headgear pulleys
    - Weight of hoisting ropes
    - Cages
    - Guide ropes
  - To guide the cage to banking level
  - It should withstand dead and live loads and wind pressure
- **Dead loads –** They are reasonably constant and calculable
- **Live loads –** It is variable depending upon the length of the ropes in the shaft, the contents of the cage and the rate of acceleration or deceleration



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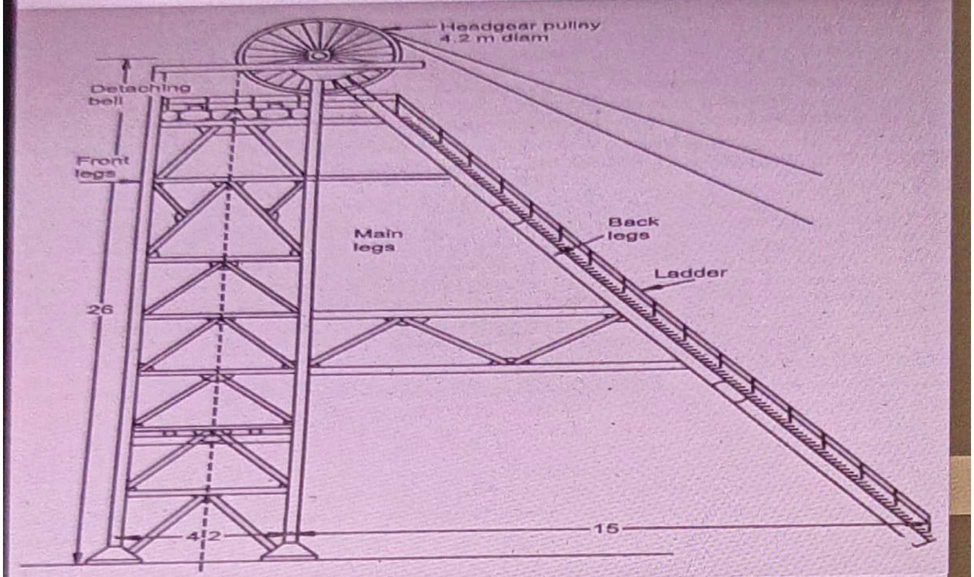
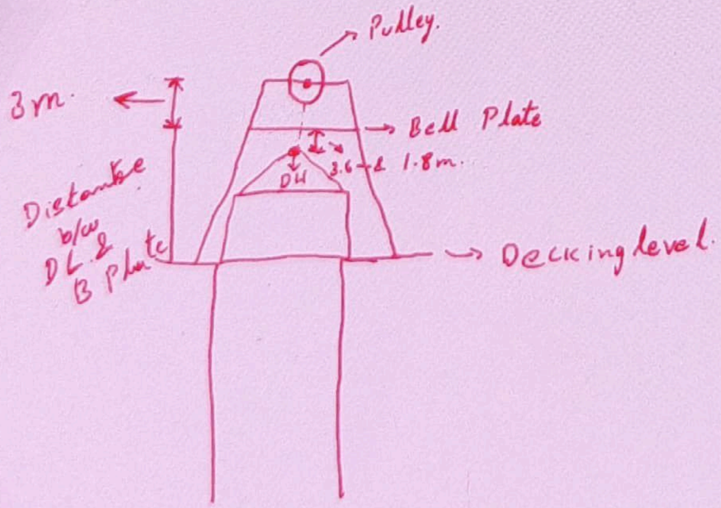
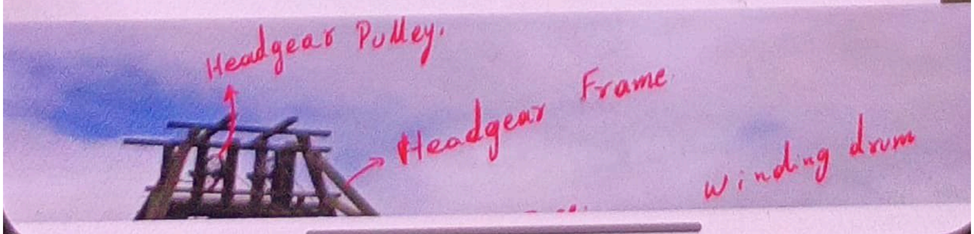
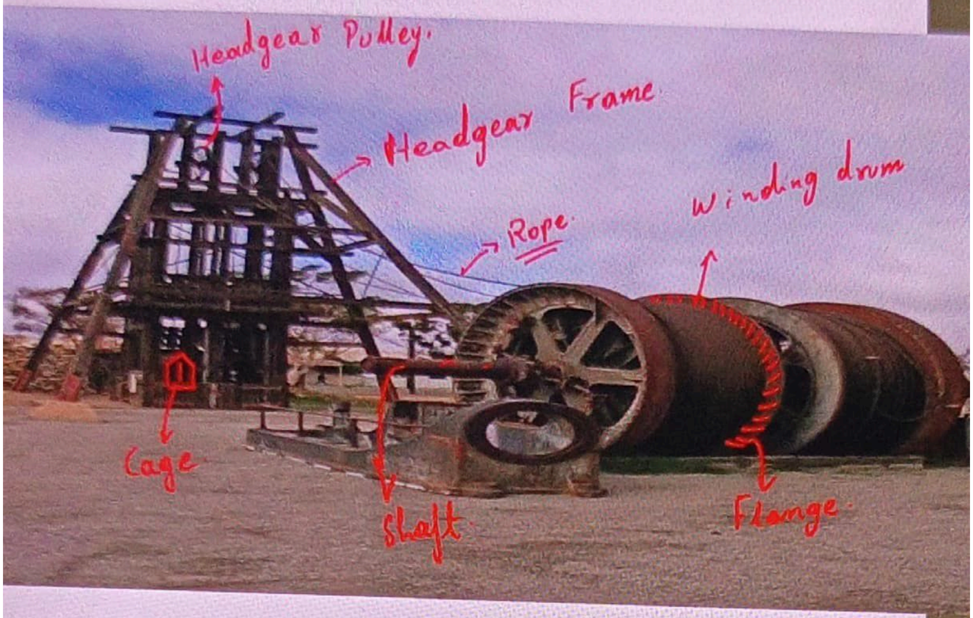

Headgear pulley 4.2 m diam
Detaching bell
Front legs
Main legs
Back legs
Ladder
26
4.2
15

- Headgear has two vertical main legs and two inclined back legs (towards the winding engine room)
- The height of the headgear is decided by considerations of number of decks on a cage, banking level or skip discharging point, pit top layout and depth of the shaft.
- **Level of detaching plate or bell above the decking level is equal to the overall height of cage/skip + length of cage chains and suspension gear + 3m – 7m margin**
- The headgear pulleys should be at height above the detaching plate before the rope capel is released before it comes into contact with headgear pulley. **The distance is about 3m.**
- **Headgear of wood are prohibited by law**


Pulley.
3m.
Bell Plate
3.6 & 1.8m.
DH
Distance b/w DL & B Plate
Decking level.

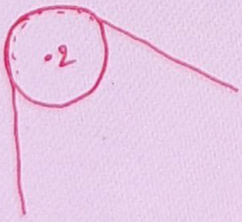

Headgear Pulley.
Headgear Frame
Winding drum

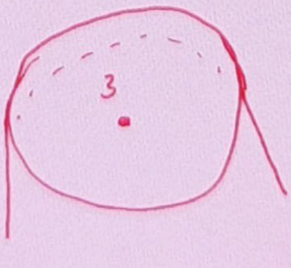


Headgear Pulley

- The dia of the headgear pulley shall be as large as to minimise bending stresses in the winding rope. Its dia should be **at least 100 times the rope dia. Pulleys of over 2.5m dia are generally constructed in two halves** and bolted together.
- **Dia of the grooves** of the headgear pulley should be **110% of the rope dia for stranded ropes and 105% of the rope dia for locked coil rope** to ensure that **1/3rd of the circumference of the rope is in contact** with the groove.
- The **fleet angle should not exceed 1.5°, more fleet angle results in wear of the rope and wear of the pulley also.**
- In case of **Koepe winders fleet angle is not required because the plane of rotation of two headgear pulleys are one below another.** But they are not vertically one below another.

जितना sharp bend होगा bending stress उतना अधिक होगा





Cage

- The cage is a lift suspended from the winding rope open at both ends.
- To prevent the mine cars/tubs from falling outside the cages,

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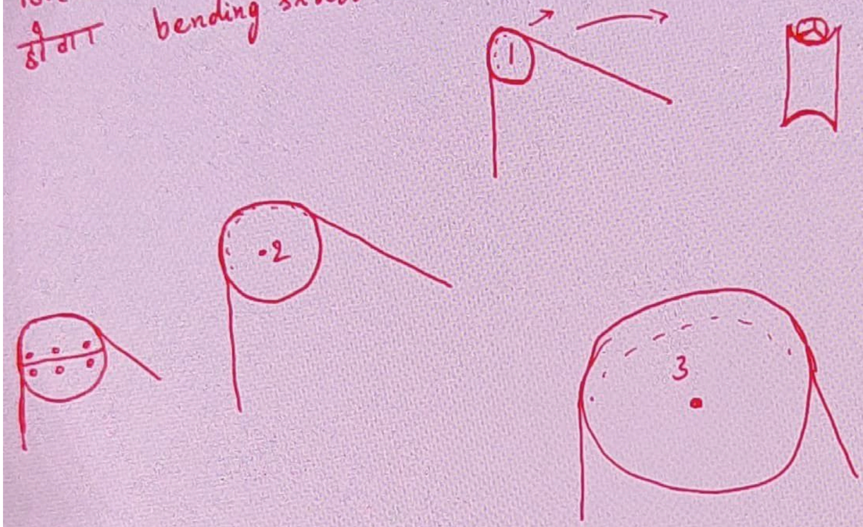
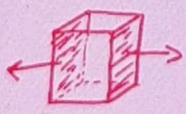
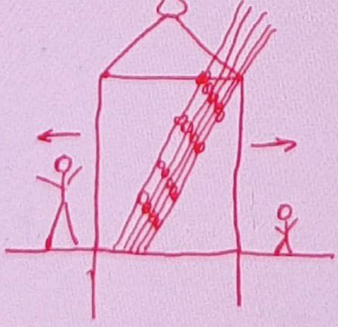
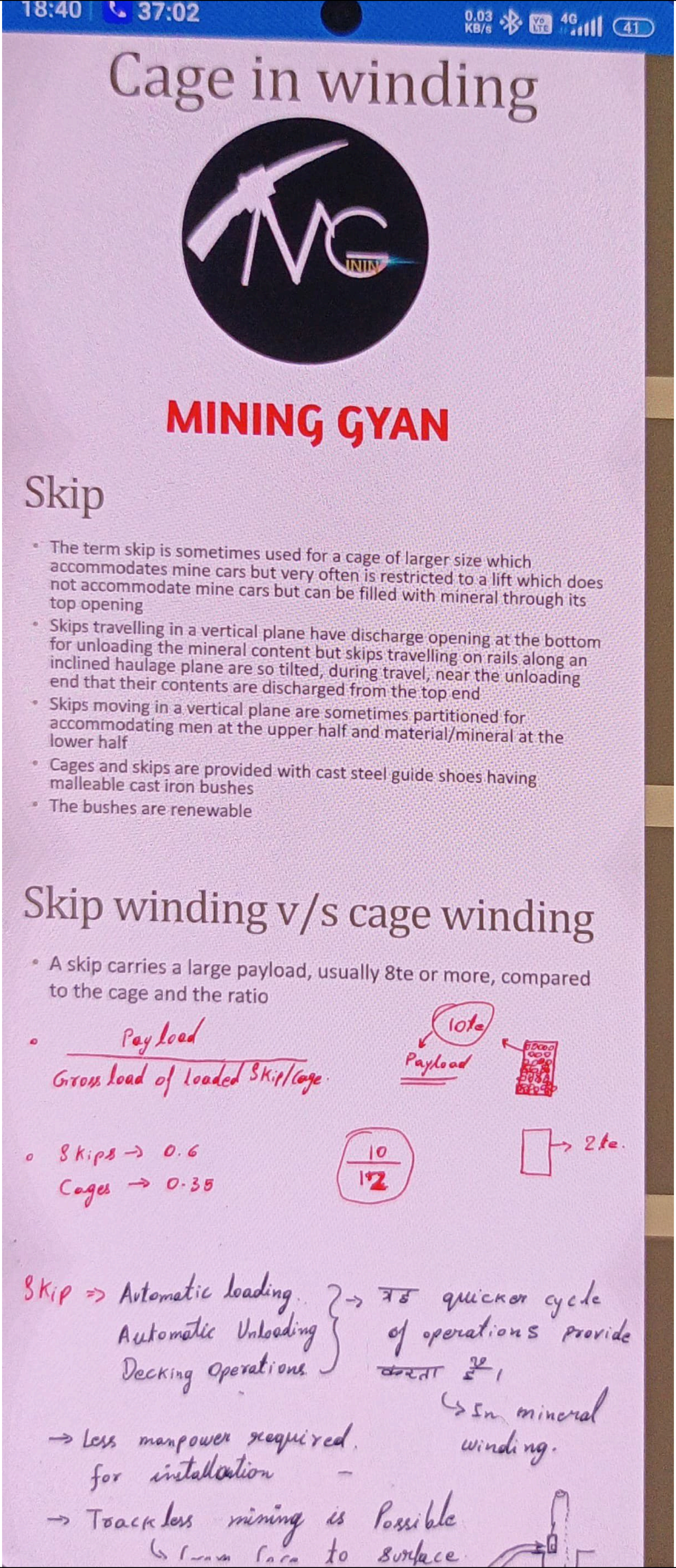


Cage

- The cage is a lift suspended from the winding rope open at both ends.
- To prevent the mine cars/tubs from falling outside the cages, catches are provided on the floor.
- The roof has a hinged or removable door for accommodating long timber or rails whenever necessary.
- A cage which can accommodate only a single tub is called a single cage, **a cage which can accommodate two tubs is called tandem cage**







Cage in winding

MINING GYAN

Skip

- The term skip is sometimes used for a cage of larger size which accommodates mine cars but very often is restricted to a lift which does not accommodate mine cars but can be filled with mineral through its top opening
- Skips travelling in a vertical plane have discharge opening at the bottom for unloading the mineral content but skips travelling on rails along an inclined haulage plane are so tilted, during travel, near the unloading end that their contents are discharged from the top end
- Skips moving in a vertical plane are sometimes partitioned for accommodating men at the upper half and material/mineral at the lower half
- Cages and skips are provided with cast steel guide shoes having malleable cast iron bushes
- The bushes are renewable

Skip winding v/s cage winding

- A skip carries a large payload, usually 8te or more, compared to the cage and the ratio

$$\frac{\text{Payload}}{\text{Gross load of loaded Skip/Cage}}$$

10te → Payload

Skips → 0.6
Cages → 0.35

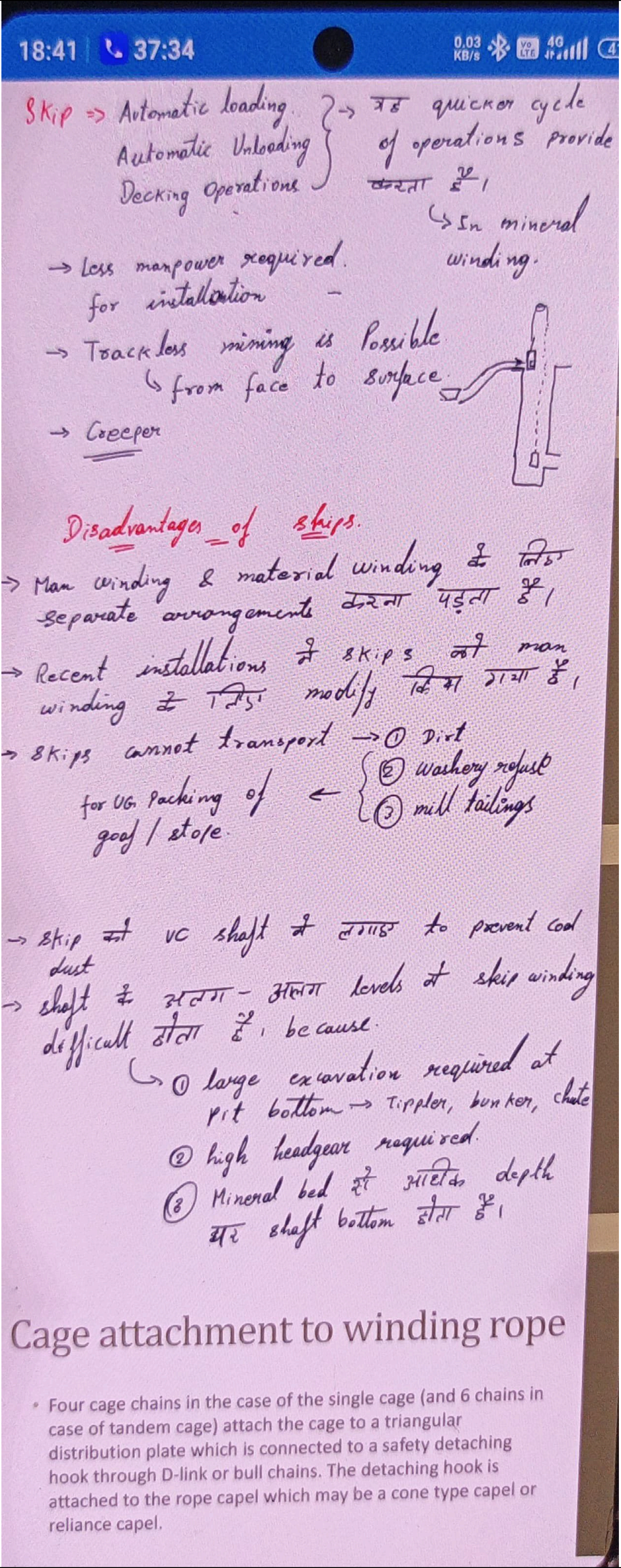
$$\boxed{\frac{10}{12}}$$

→ 2te.

Skip ⇒ Automatic loading
Automatic Unloading
Decking Operations
→ यह quicker cycle of operations provide करता है।
↳ In mineral winding.

→ Less manpower required for installation

→ Trackless mining is Possible
↳ from face to surface



Skip => Automatic loading
Automatic Unloading
Decking Operations } → यह quicker cycle of operations provide करता है।
↳ In mineral winding.

→ Less manpower required for installation

→ Trackless mining is Possible
↳ from face to surface

→ Creeper

Disadvantages of skips.

→ Man winding & material winding के लिए separate arrangements करना पड़ता है।

→ Recent installations में skips को man winding के लिए modify किया गया है।

→ Skips cannot transport → ① Dirt
② washery refuse
③ mill tailings
→ for UG Packing of goaf / stope.

→ Skip को UC shaft में लगाए to prevent coal dust

→ shaft के अलग-अलग levels से skip winding difficult होता है। because
↳ ① large excavation required at pit bottom → Tippler, bunker, chute
② high headgear required.
③ Mineral bed से अधिक depth पर shaft bottom होता है।

Cage attachment to winding rope

- Four cage chains in the case of the single cage (and 6 chains in case of tandem cage) attach the cage to a triangular distribution plate which is connected to a safety detaching hook through D-link or bull chains. The detaching hook is attached to the rope capel which may be a cone type capel or reliance capel.

(8) Mineral bed से आधिक depth पर shaft bottom होता है।

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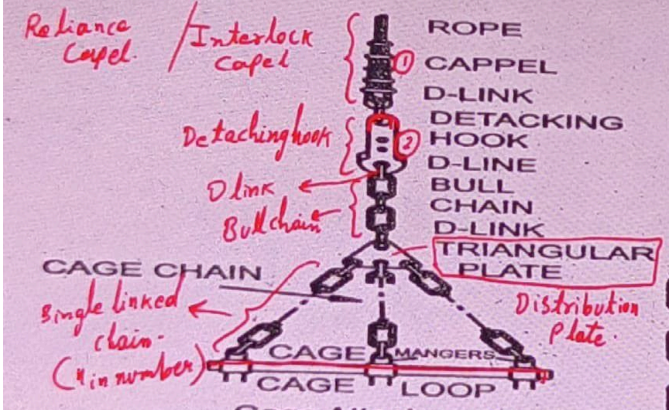
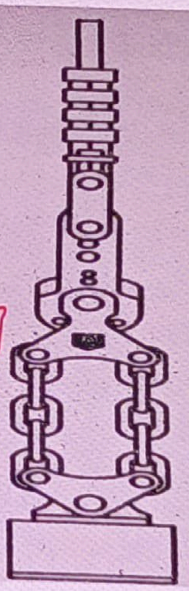
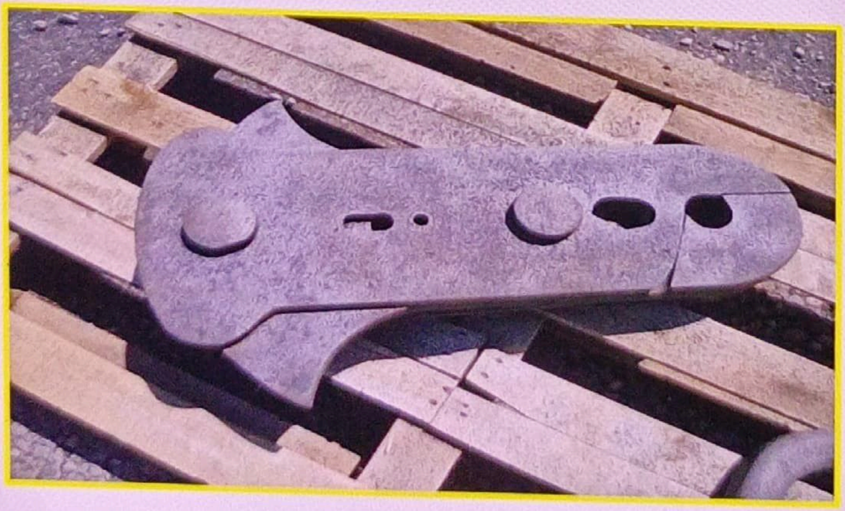
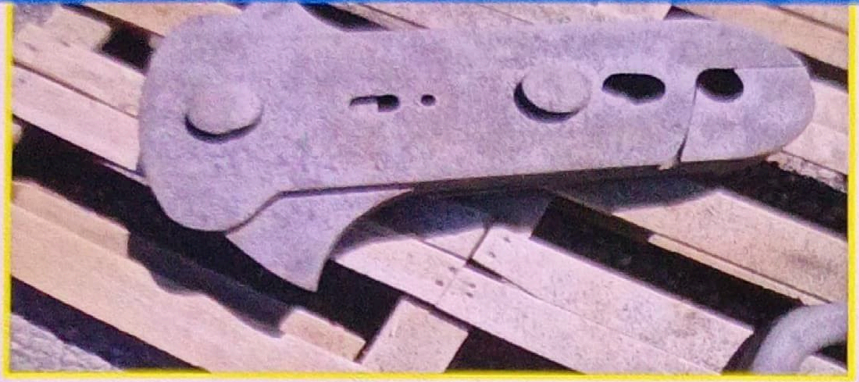
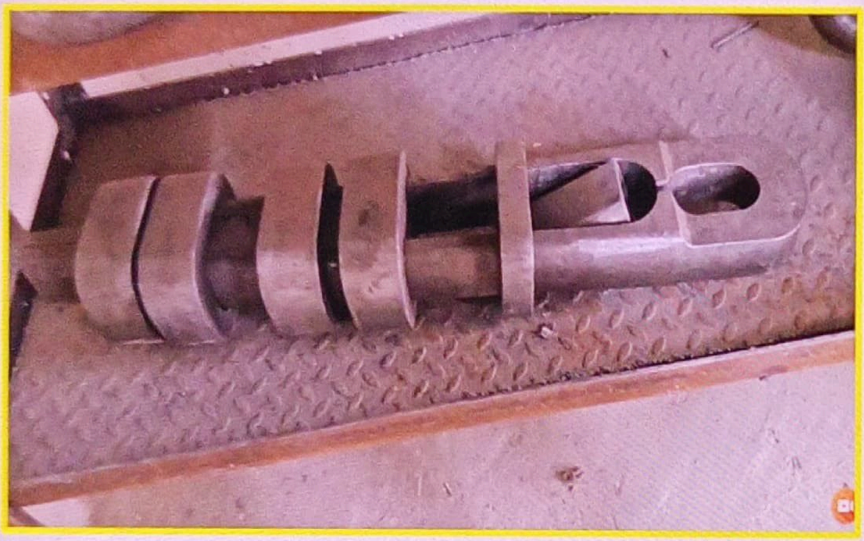

Reliance Capel
/Interlock Capel
ROPE
① CAPPEL
D-LINK
Detachinghook
② DETACKING HOOK
D-LINE
D link
BULL CHAIN
Bullchain
D-LINK
TRIANGULAR PLATE
Distribution Plate.
CAGE CHAIN
Single linked chain (4 in number)
CAGE
MANGERS
CAGE LOOP

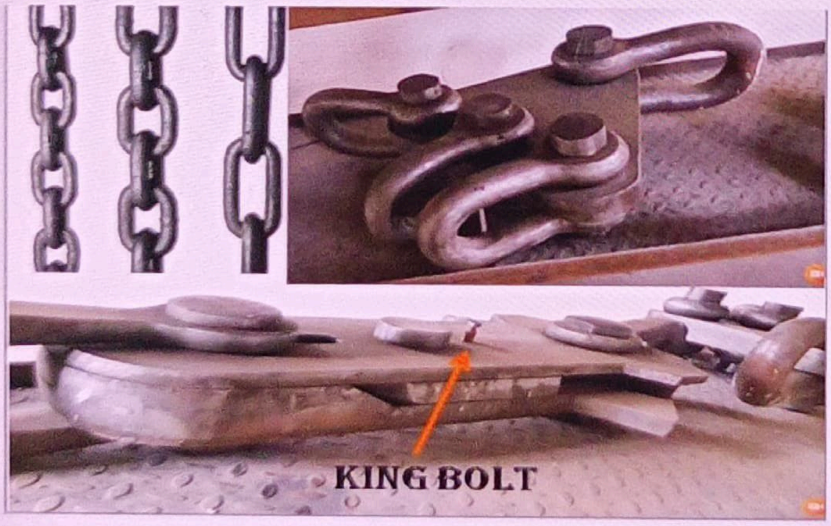
Cage Attachments

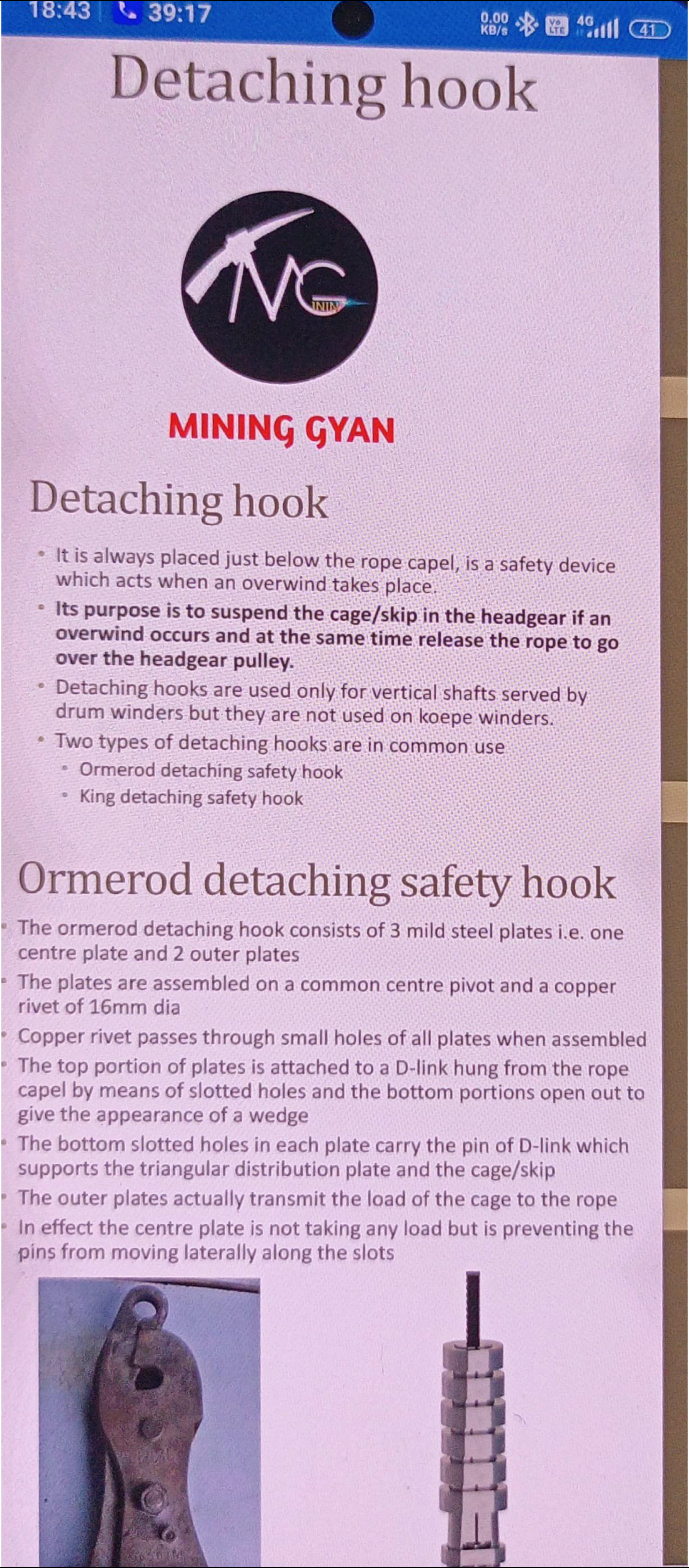









KING BOLT



Detaching hook

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Detaching hook

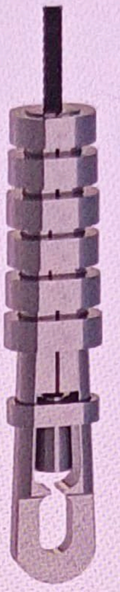
- It is always placed just below the rope capel, is a safety device which acts when an overwind takes place.
- **Its purpose is to suspend the cage/skip in the headgear if an overwind occurs and at the same time release the rope to go over the headgear pulley.**
- Detaching hooks are used only for vertical shafts served by drum winders but they are not used on koepe winders.
- Two types of detaching hooks are in common use
  - Ormerod detaching safety hook
  - King detaching safety hook

Ormerod detaching safety hook

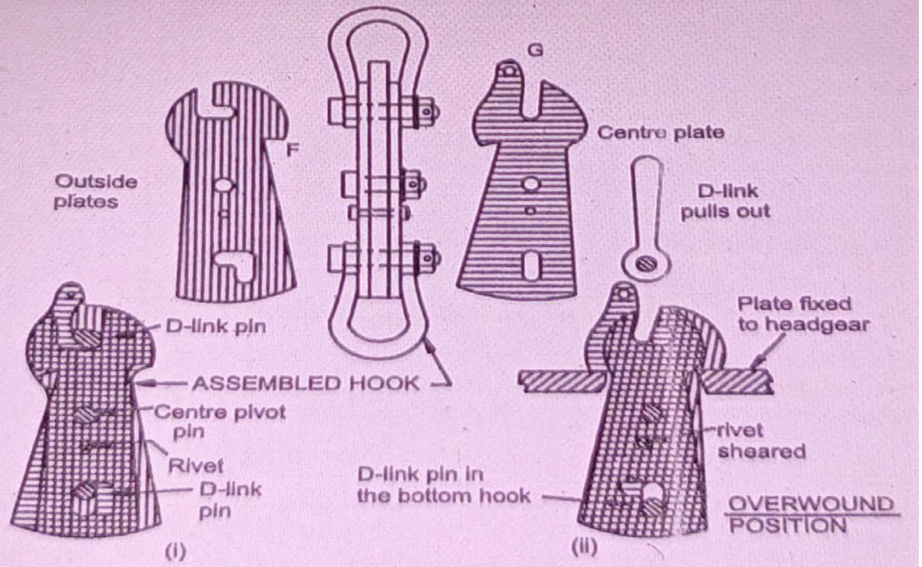
- The ormerod detaching hook consists of 3 mild steel plates i.e. one centre plate and 2 outer plates
- The plates are assembled on a common centre pivot and a copper rivet of 16mm dia
- Copper rivet passes through small holes of all plates when assembled
- The top portion of plates is attached to a D-link hung from the rope capel by means of slotted holes and the bottom portions open out to give the appearance of a wedge
- The bottom slotted holes in each plate carry the pin of D-link which supports the triangular distribution plate and the cage/skip
- The outer plates actually transmit the load of the cage to the rope
- In effect the centre plate is not taking any load but is preventing the pins from moving laterally along the slots

give the appearance of a wedge

- The bottom slotted holes in each plate carry the pin of D-link which supports the triangular distribution plate and the cage/skip
- The outer plates actually transmit the load of the cage to the rope
- In effect the centre plate is not taking any load but is preventing the pins from moving laterally along the slots



- A plate or a bell set securely fixed on the horizontal member of the headgear frame, a few metres below the headgear pulleys, is required for operation of the safety hook is of overwind
- The hook in its assembled form cannot pass clear through the bell set
- When an overwind takes place and the ascending cage rises high enough for the hook to pass through the bell
- The wedge shaped portions of the outer plates are pressed inwards
- This causes the copper rivet to shear
- The plates open out at the top, releasing the D-link pin of the rope capel which then passes over the headgear pulley
- After an overwind, to put the cage back in operation, cover the pit top with a few rails so that the cage/skip, if accidentally released during restoration operation, does not fall through pit
- To remove safety hook from bell set, attach the rope to the top hole of the centre plate by a D-link


G
Outside plates
F
Centre plate
D-link pulls out
D-link pin
Plate fixed to headgear
ASSEMBLED HOOK
Centre pivot pin
rivet sheared
Rivet
D-link pin
D-link pin in the bottom hook
OVERWOUND POSITION
(i)
(ii)

King detaching safety hook

- It consists of 4 wrought iron plates, i.e. two being movable inner plates and two fixed outer plates.
- The two inner plates are placed together in opposite ways so that the hook of

capel which then passes over the headgear pulley

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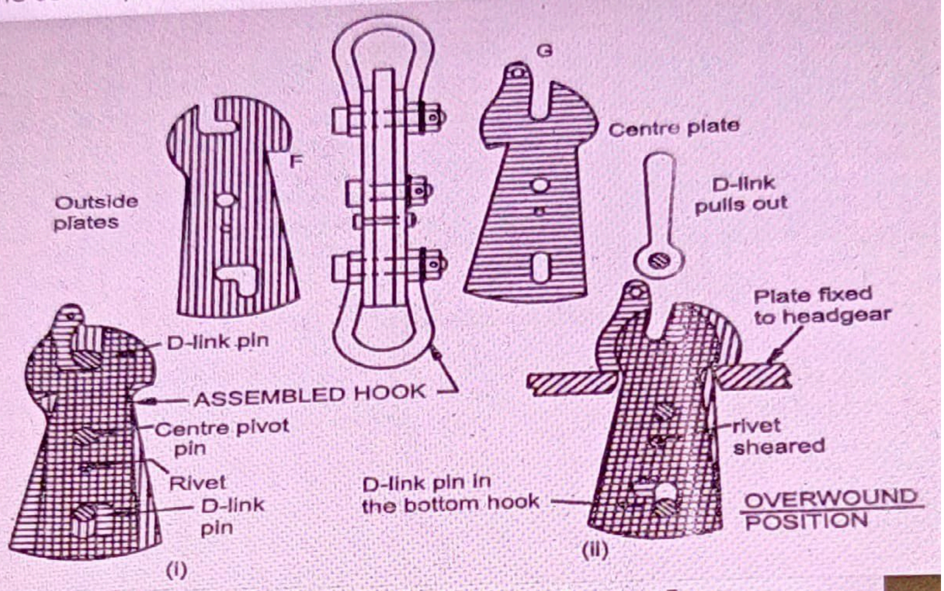
Outside plates
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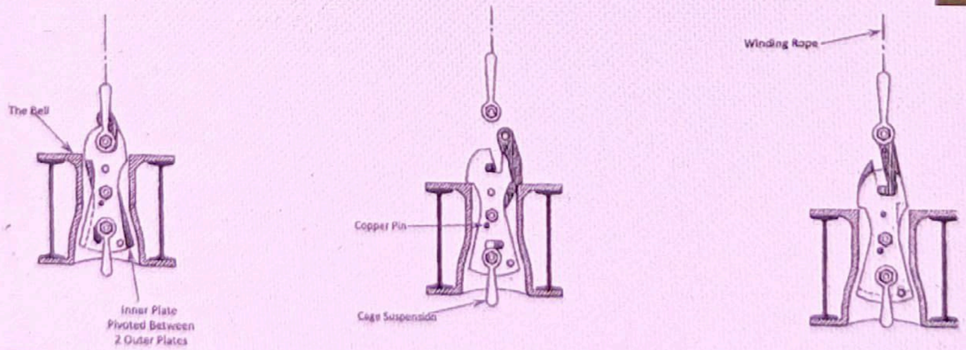
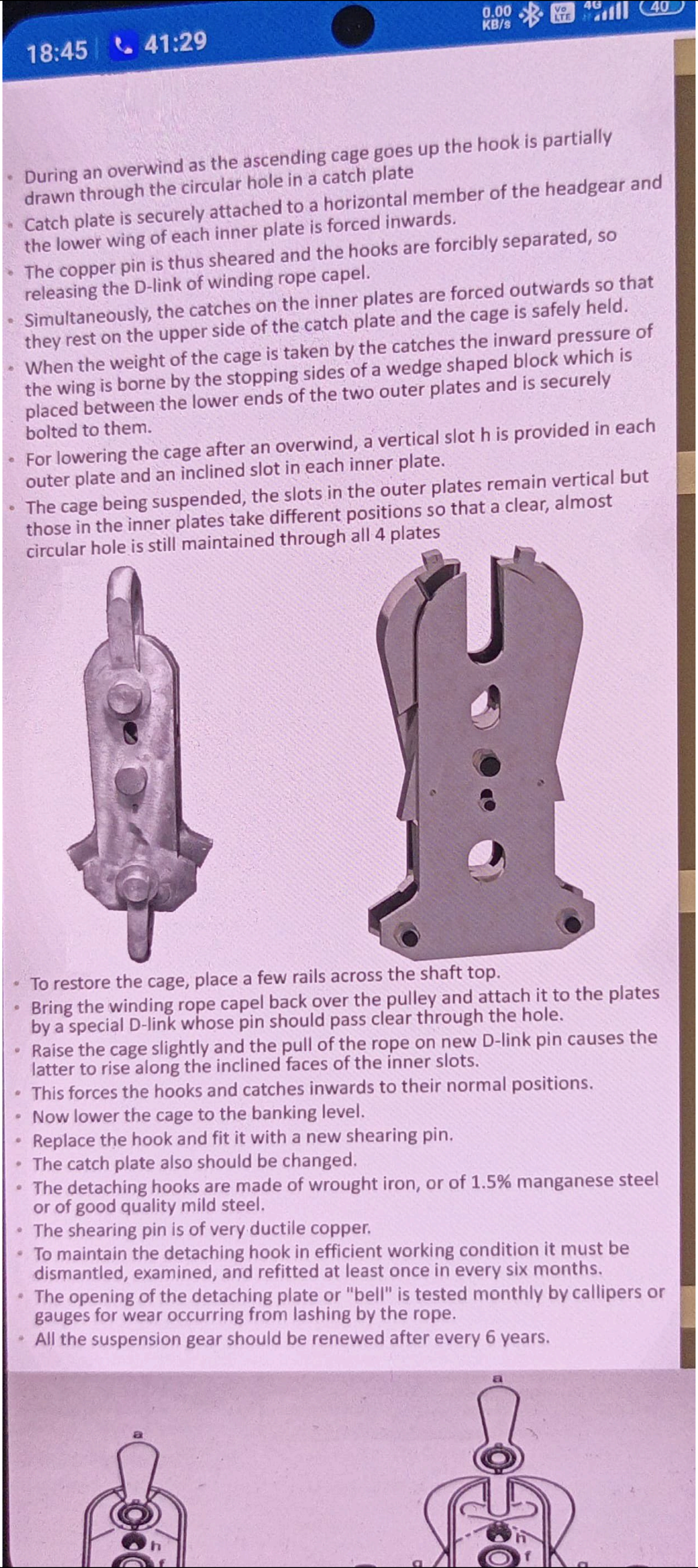
OVERWOUND POSITION
(i)
(ii)

King detaching safety hook

- It consists of 4 wrought iron plates, i.e. two being movable inner plates and two fixed outer plates.
- The two inner plates are placed together in opposite ways so that the hook of one plate and that of other jointly form a secure hole for the reception of the rope capel bolt.
- A main bolt or centre-pin passes through the holes in all four plates and serves
  - To bind the plates together;
  - To transmit the tension of winding rope from the hooks of the inner plates to the shackle-bolt of the main D-link (placed through the hole O in the outer plates);
  - To provide a pivot on which the two inner plates can move.
- The hooks are so curved that pull of the winding rope has no tendency to open out the inner plates.
- A copper pin is placed through the holes in all four plates and riveted over to prevent inadvertent movement of the inner plates when they are not under tension.


The Bell
Inner Plate Pivoted Between 2 Outer Plates
Copper Pin
Cage Suspension
Winding Rope

- During an overwind as the ascending cage goes up the hook is partially drawn through the circular hole in a catch plate
- Catch plate is securely attached to a horizontal member of the headgear and the lower wing of each inner plate is forced inwards.
- The copper pin is thus sheared and the hooks are forcibly separated, so releasing the D-link of winding rope capel.



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- Catch plate is securely attached to a horizontal member of the headgear and the lower wing of each inner plate is forced inwards.
- The copper pin is thus sheared and the hooks are forcibly separated, so releasing the D-link of winding rope capel.
- Simultaneously, the catches on the inner plates are forced outwards so that they rest on the upper side of the catch plate and the cage is safely held.
- When the weight of the cage is taken by the catches the inward pressure of the wing is borne by the stopping sides of a wedge shaped block which is placed between the lower ends of the two outer plates and is securely bolted to them.
- For lowering the cage after an overwind, a vertical slot h is provided in each outer plate and an inclined slot in each inner plate.
- The cage being suspended, the slots in the outer plates remain vertical but those in the inner plates take different positions so that a clear, almost circular hole is still maintained through all 4 plates

- To restore the cage, place a few rails across the shaft top.
- Bring the winding rope capel back over the pulley and attach it to the plates by a special D-link whose pin should pass clear through the hole.
- Raise the cage slightly and the pull of the rope on new D-link pin causes the latter to rise along the inclined faces of the inner slots.
- This forces the hooks and catches inwards to their normal positions.
- Now lower the cage to the banking level.
- Replace the hook and fit it with a new shearing pin.
- The catch plate also should be changed.
- The detaching hooks are made of wrought iron, or of 1.5% manganese steel or of good quality mild steel.
- The shearing pin is of very ductile copper.
- To maintain the detaching hook in efficient working condition it must be dismantled, examined, and refitted at least once in every six months.
- The opening of the detaching plate or "bell" is tested monthly by callipers or gauges for wear occurring from lashing by the rope.
- All the suspension gear should be renewed after every 6 years.

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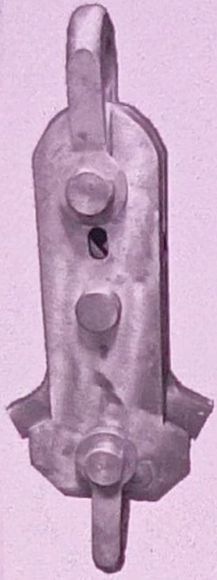

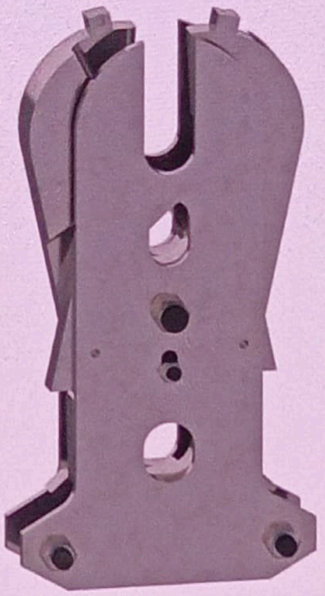

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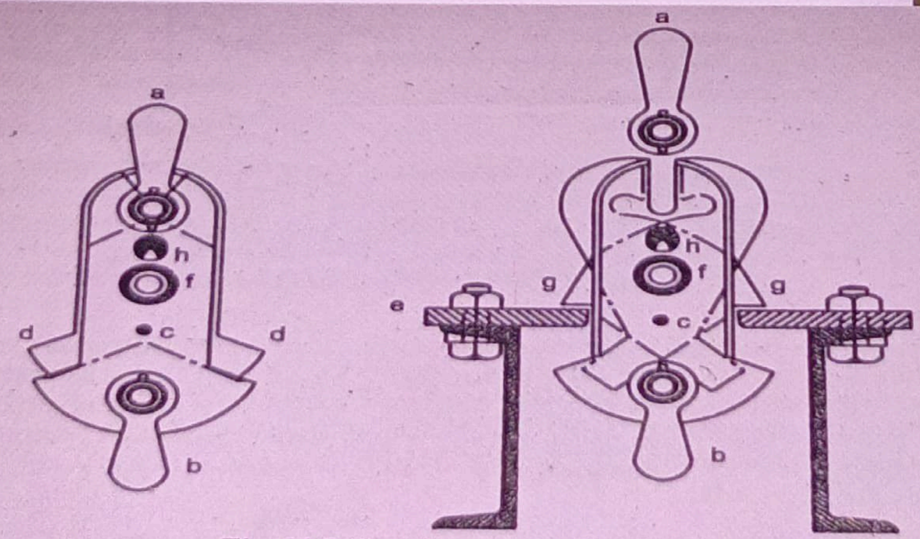
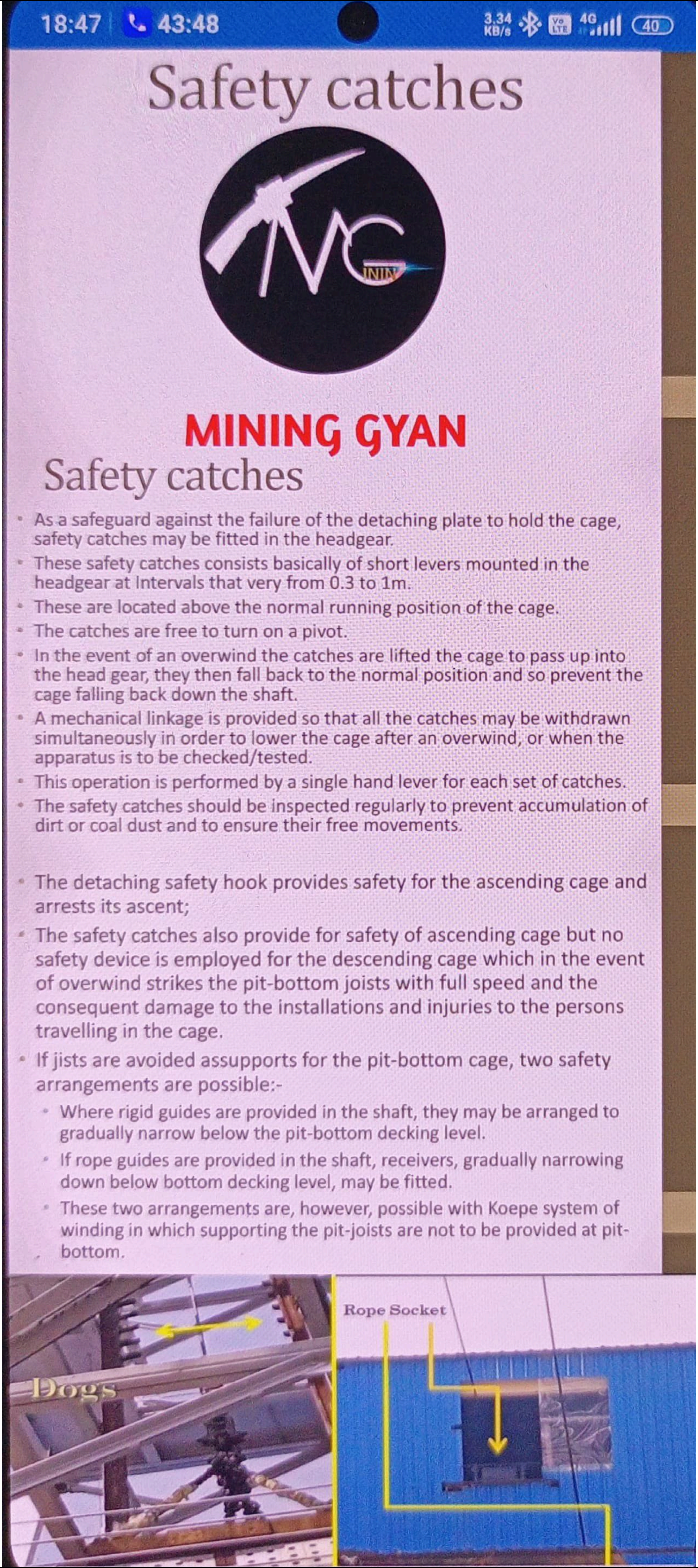


Fig. 11.7 King detaching safety hook



Safety catches

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Safety catches

- As a safeguard against the failure of the detaching plate to hold the cage, safety catches may be fitted in the headgear.
- These safety catches consists basically of short levers mounted in the headgear at Intervals that very from 0.3 to 1m.
- These are located above the normal running position of the cage.
- The catches are free to turn on a pivot.
- In the event of an overwind the catches are lifted the cage to pass up into the head gear, they then fall back to the normal position and so prevent the cage falling back down the shaft.
- A mechanical linkage is provided so that all the catches may be withdrawn simultaneously in order to lower the cage after an overwind, or when the apparatus is to be checked/tested.
- This operation is performed by a single hand lever for each set of catches.
- The safety catches should be inspected regularly to prevent accumulation of dirt or coal dust and to ensure their free movements.

- The detaching safety hook provides safety for the ascending cage and arrests its ascent;
- The safety catches also provide for safety of ascending cage but no safety device is employed for the descending cage which in the event of overwind strikes the pit-bottom joists with full speed and the consequent damage to the installations and injuries to the persons travelling in the cage.
- If jists are avoided assupports for the pit-bottom cage, two safety arrangements are possible:-
  - Where rigid guides are provided in the shaft, they may be arranged to gradually narrow below the pit-bottom decking level.
  - If rope guides are provided in the shaft, receivers, gradually narrowing down below bottom decking level, may be fitted.
  - These two arrangements are, however, possible with Koepe system of winding in which supporting the pit-joists are not to be provided at pit-bottom.

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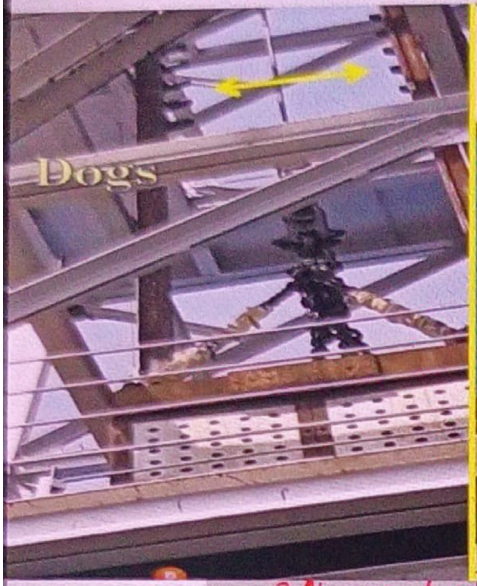
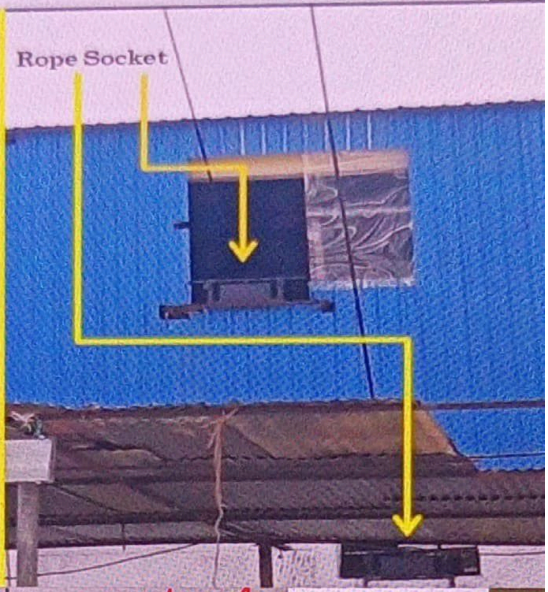
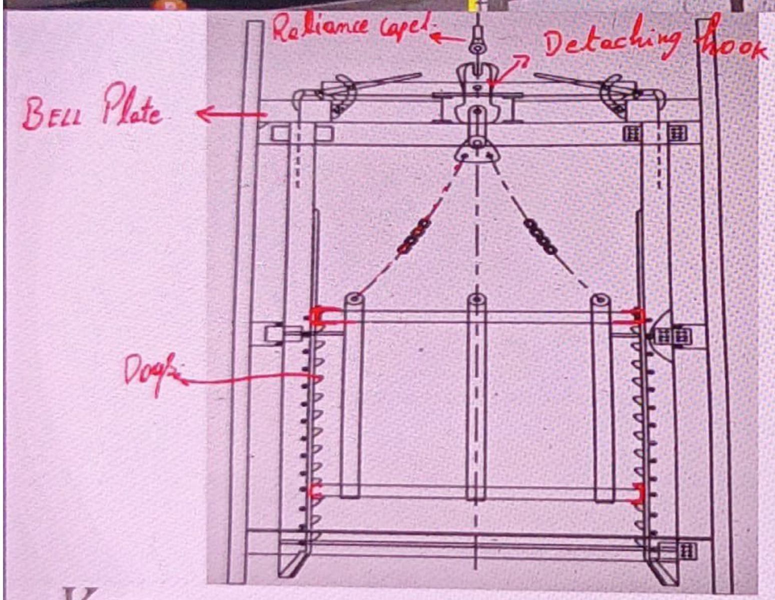






Keps

- Keps are retractable supports for cages and have to be used at the pit top under our mining regulations.
- Their use is not necessary at the pit bottom as the cages rest on the rigid platform of steel girders and wooden planks
- Keps are not required at the mid-set landing and in a shaft served by koepe winding system.
- Keps ensure not only support to the cage but their use results in proper alignment of the cage-floor and decking level so that the stretch of the winding rope creates no difficulties arise and are overcome by the use of titled or hinged platforms.

- Keps are manually operated by the banksman at the pit top. The ascending cage pushes the keps back and as it is raised slightly higher than the decking level, the keps fall back in position by gravity as the banksman releases the operating lever.
- The cage, after it has come to a halt, is lowered by the winding

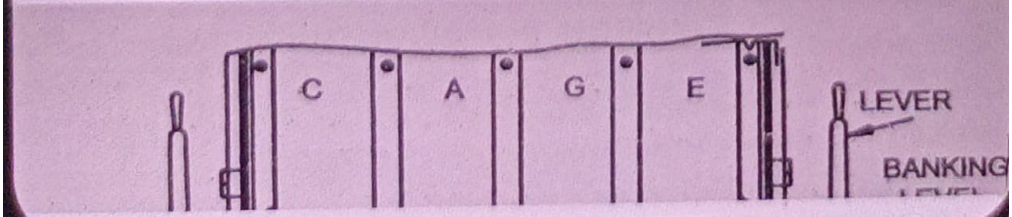
proper alignment of the cage-floor and decking level so that the stretch of the winding rope creates no difficulties arise and are overcome by the use of titled or hinged platforms.

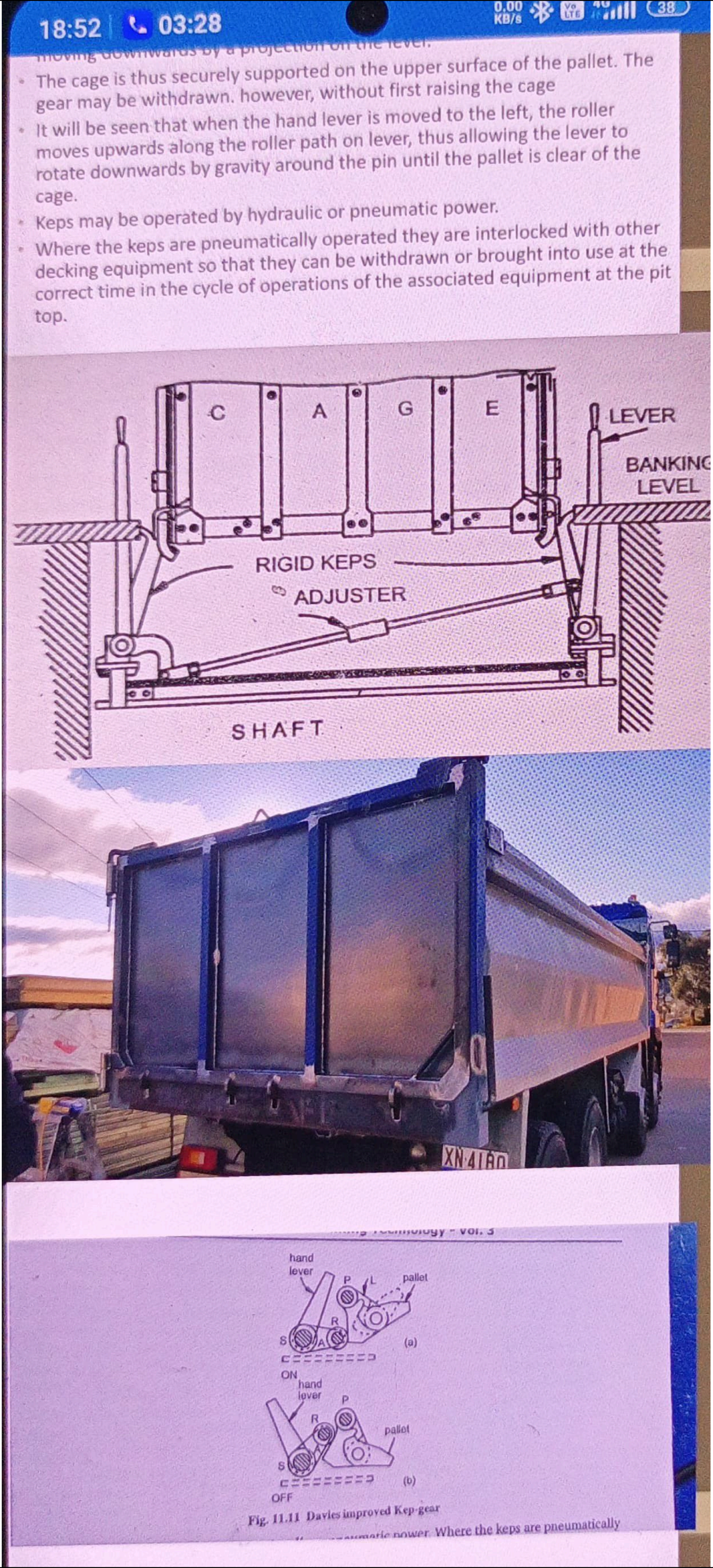
- Keps are manually operated by the banksman at the pit top. The ascending cage pushes the keps back and as it is raised slightly higher than the decking level, the keps fall back in position by gravity as the banksman releases the operating lever.
- The cage, after it has come to a halt, is lowered by the winding engineman to rest on the keps.
- When the top cage is to start on its downward journey, the winding engineman raises the cage only slightly to make it clear of the keps, the banksman withdraws the latter by manual operation of a leaver which is held by him till the cage is lowered past the keps.

Disadvantages of rigid keps

- Accumulation of slack rope on the pit bottom cage when the top cage is raised a little for withdrawal of keps.
- Ascent of the pit bottom cage is generally associated with shock load on the winding rope and the stress may amount to nearly 200 % of the static load.
- Loss of time and power of lifting the top cage before its downward travel.
- Because of these defects keps have been devised which can be withdrawn from under the cage without lifting it.
- Notable of such keps are the Stauss keps and the Davies' improved keps gear.
- The gear consists essentially of the shafts to which is keyed the hand lever and a pair of arms with a steel roller mounted on a pin between the arms.

- The roller presses against a renewable roller path on a swing-lever which is pivoted and carries a "pallet" mounted on a steel pin at its other end.
- The pallet is free to move upward and around this pin.
- Thus permitting the upward passage of the cage, but it is prevented from moving downwards by a projection on the lever.
- The cage is thus securely supported on the upper surface of the pallet. The gear may be withdrawn. however, without first raising the cage
- It will be seen that when the hand lever is moved to the left, the roller moves upwards along the roller path on lever, thus allowing the lever to rotate downwards by gravity around the pin until the pallet is clear of the cage.
- Keps may be operated by hydraulic or pneumatic power.
- Where the keps are pneumatically operated they are interlocked with other decking equipment so that they can be withdrawn or brought into use at the correct time in the cycle of operations of the associated equipment at the pit top.




18:52
03:28
0.00 KB/s
38
C A G E
LEVER
BANKING LEVEL
RIGID KEPS
ADJUSTER
SHAFT
hand lever
P
L
pallet
R
S
A
(a)
ON
hand lever
P
R
pallet
S
(b)
OFF

moving downwards by a projection on the lever.

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Fig. 11.11 Davies improved Kep-gear

pneumatic power. Where the keps are pneumatically

Winding attachments

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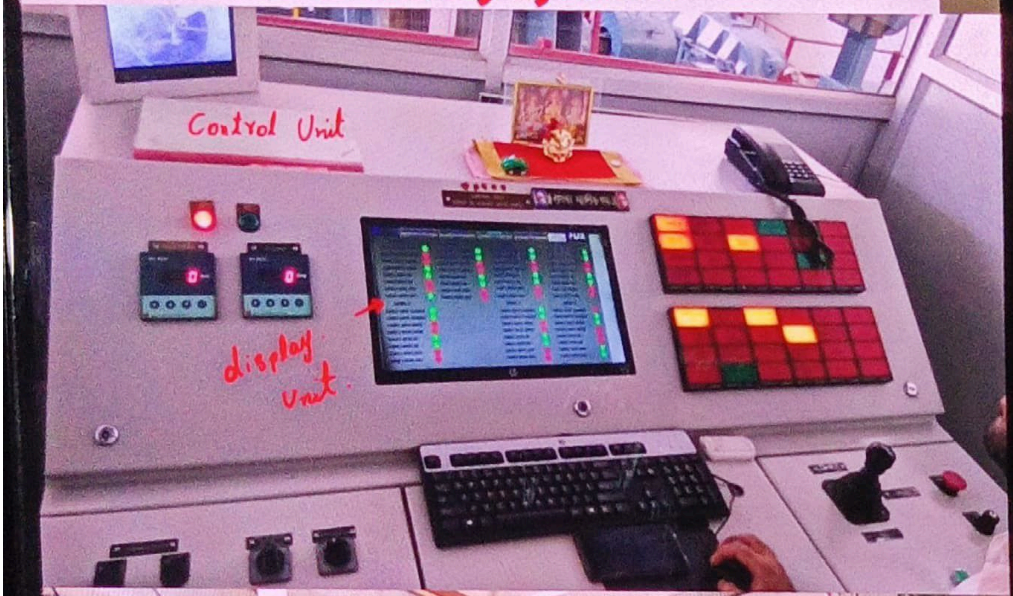
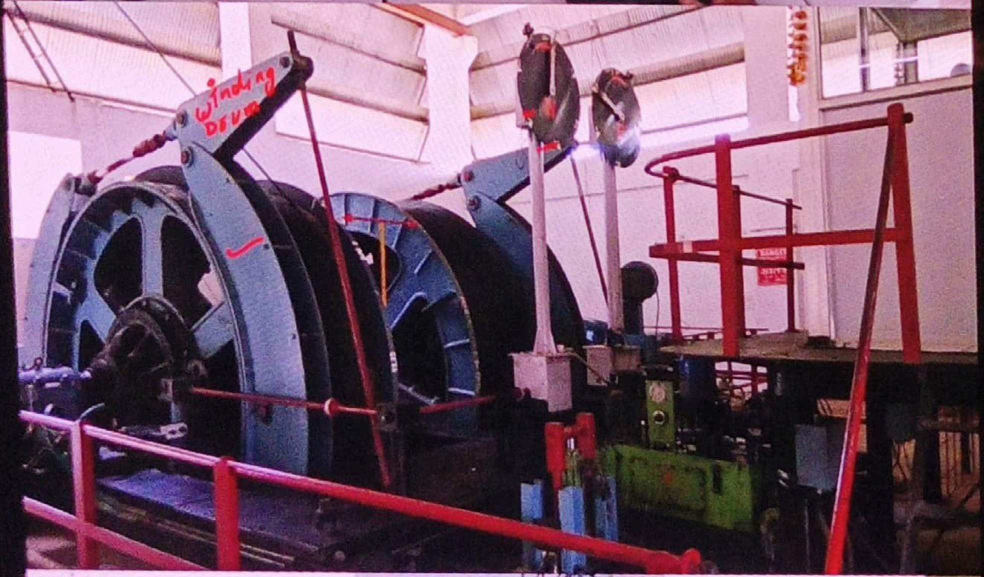
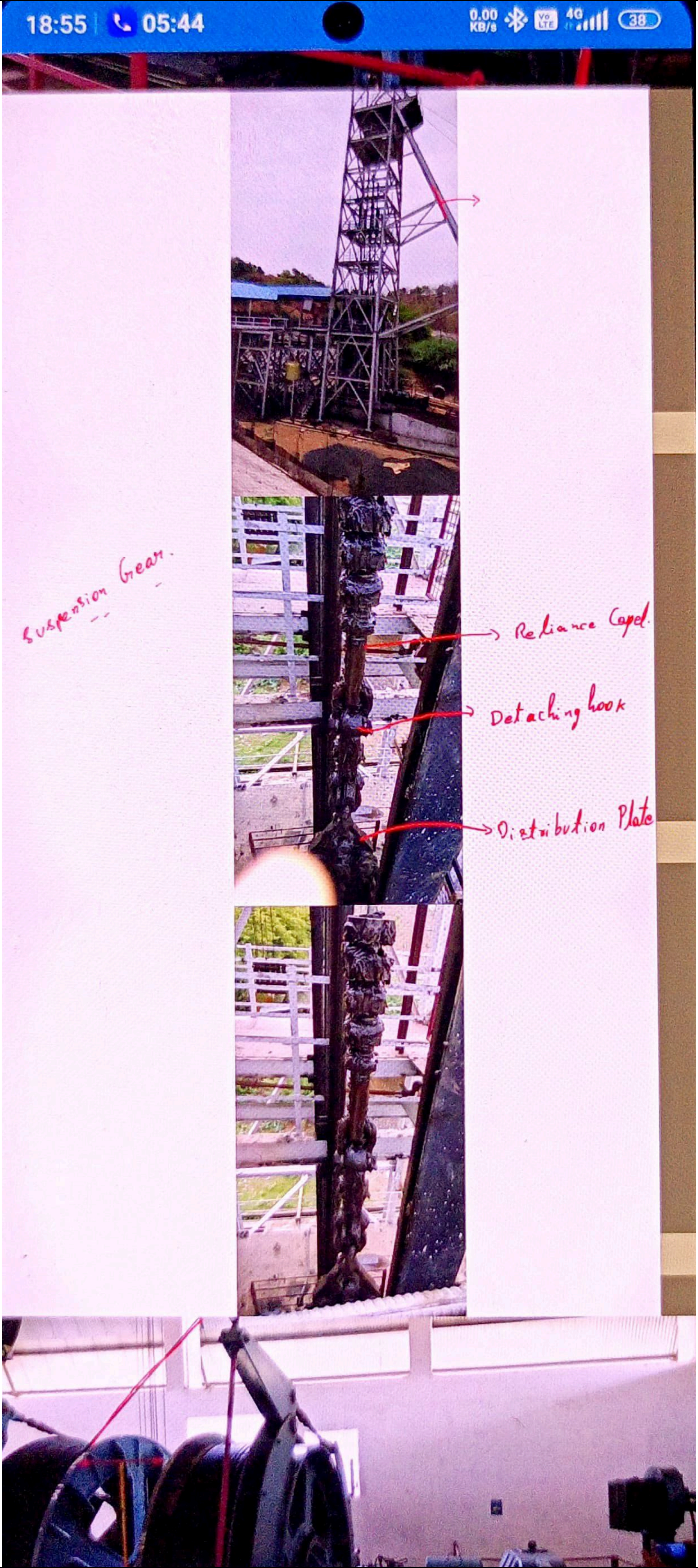

Control Unit
display Unit


winding Drum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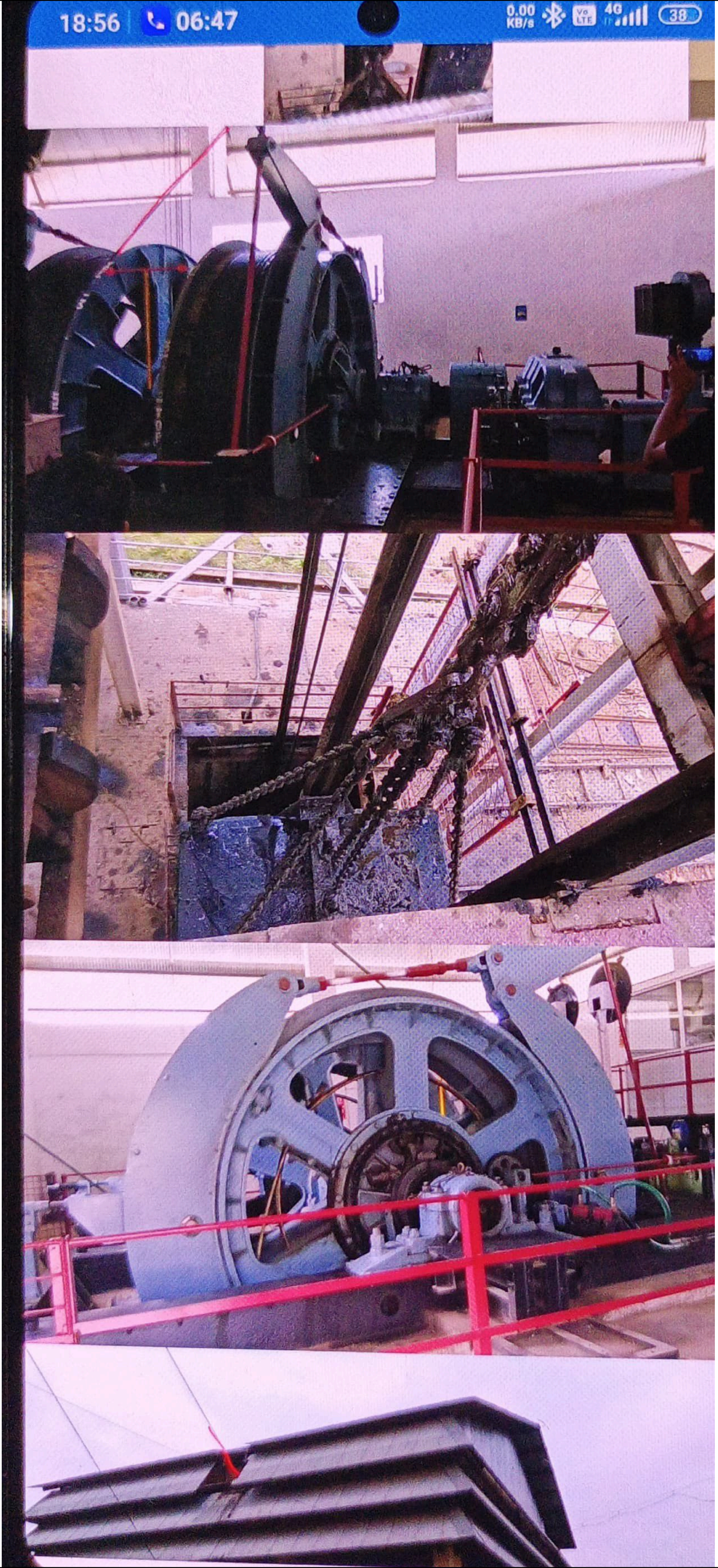
05:44
Suspension Gear.
Reliance Capel.
Detaching hook
Distribution Plate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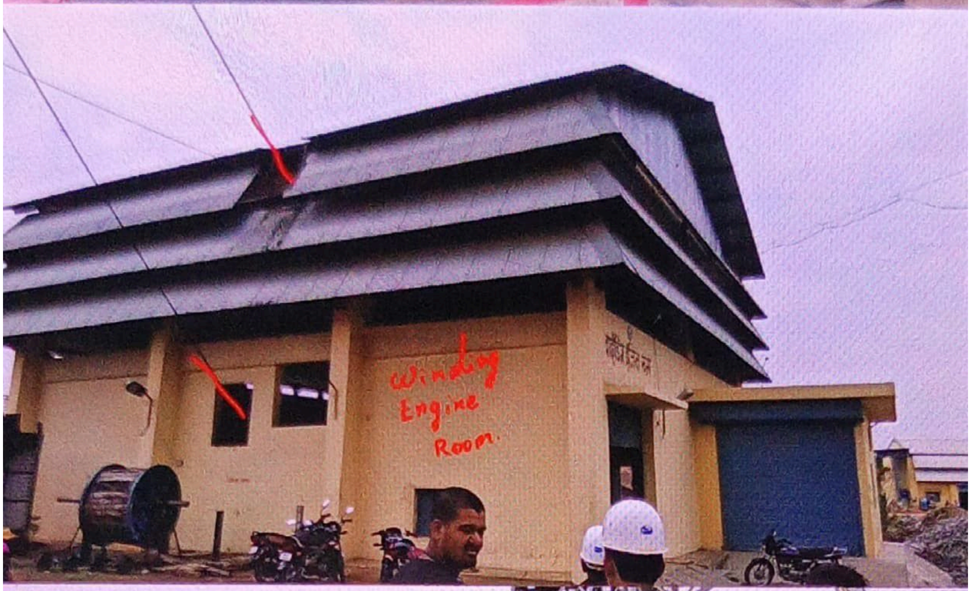
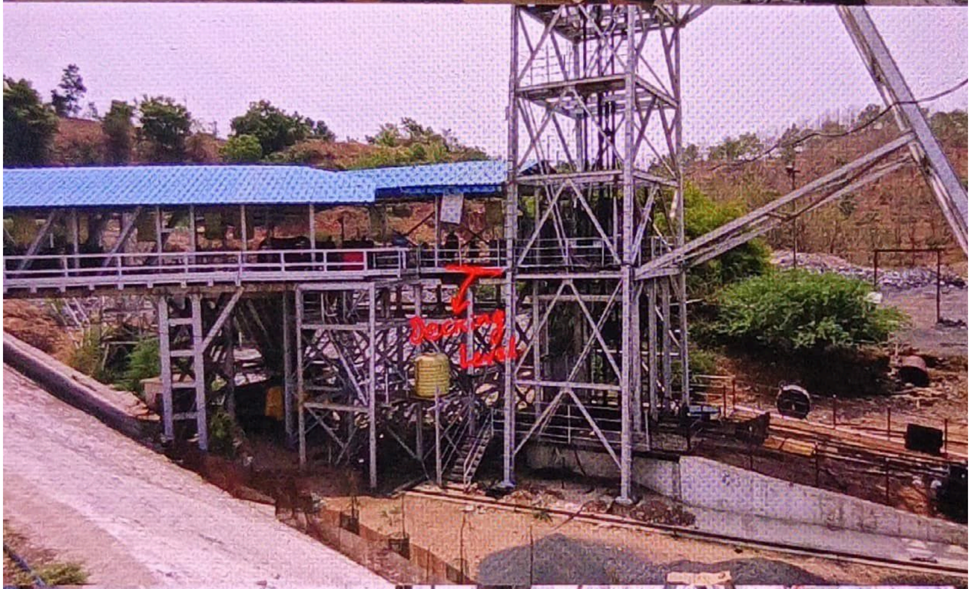
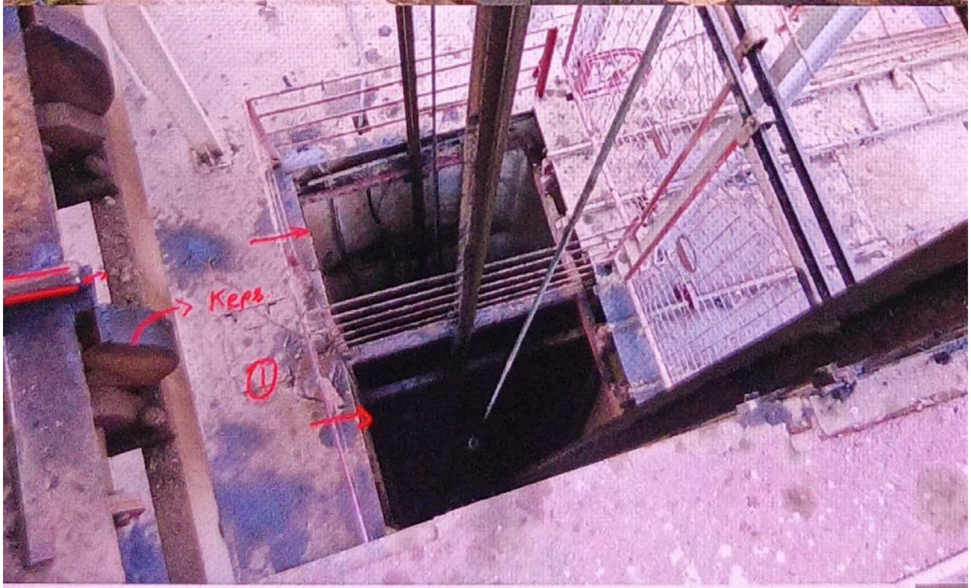
4G
38







Tilted or hinged platforms

- In deep mines the winding ropes stretch in course of use
- If keps are used at the pit top, the loading or unloading of mine cars or tubs into the cage or out of it can be done without difficulty as the cage floor is in level with the decking level when the cage rests on the keps
- In case of koepe winders the rope stretch creates problems of alignment of cage floor with decking level and platforms have to be used

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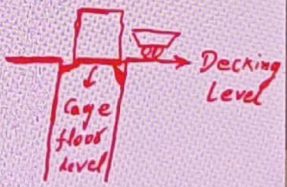
- In case of koepe winders the rope stretch creates problems of alignment of cage floor with decking level and platforms have to be used
- A tilting platform consists of swinging rails covered with steel plates
- At the frontend of the platform there are tongued rails which can be pushed down by the descending cage or pushed up by the ascending cage

→ Keps shaft के top पर Provide कराते हैं

↳ mine cars/tubs को cage से loading & Unloading करने में आसानी रहती है

क्योंकि cage floor level & decking level Keps के कारण same रहता है।

→ Koepe winders में cage की rope stretch होने के कारण Cage floor and decking level का alignment disturb हो जाता है।

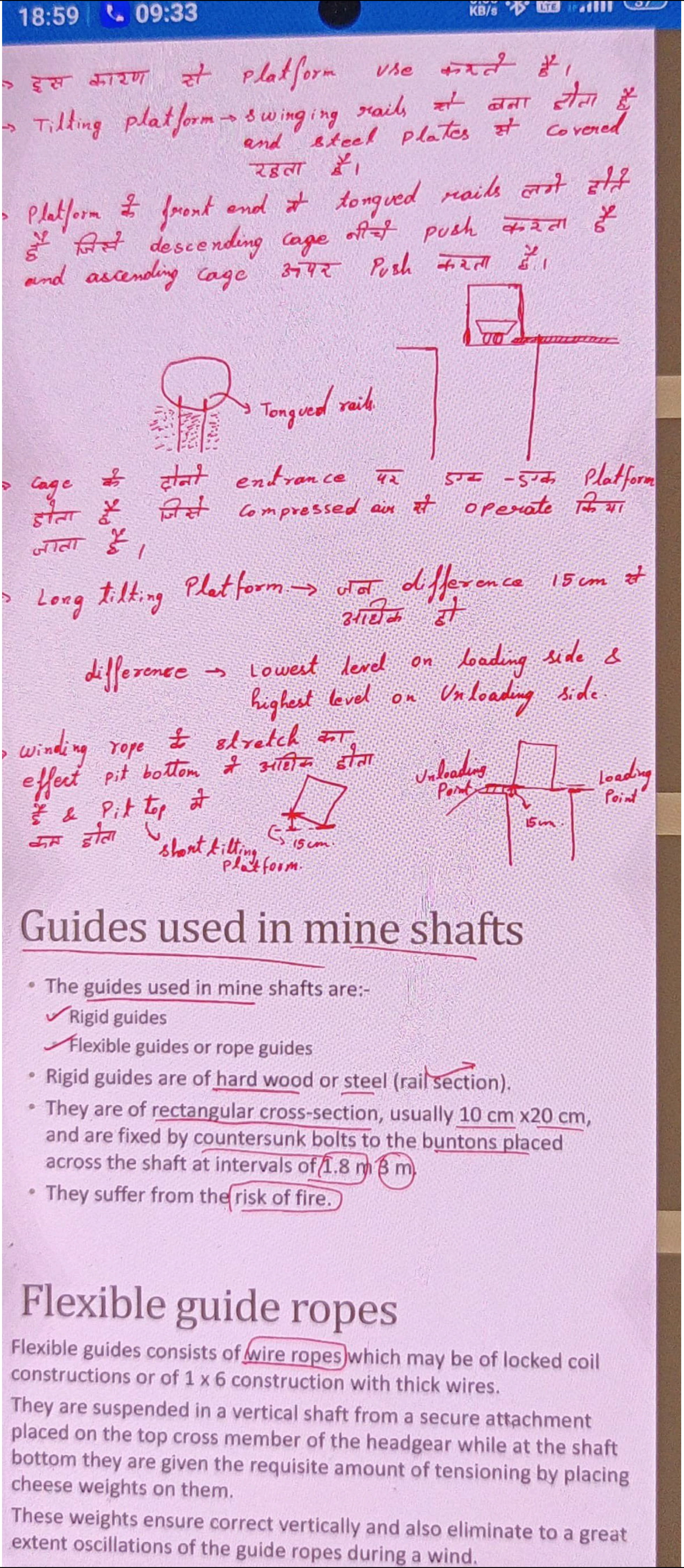


- There are two platforms one at each entrance to the cage, and these are operated separately by compressed air
- Counterweights are usually avoided because it obstructs the man riding level immediately below
- Longer tilting platform must be used when a difference of more than 15cm occurs
- The maximum difference in level must be calculated by considering the lowest level on the loading side and the highest level on the unloading side
- The stretch of the winding rope is not so great at the pit top as at the pit bottom and so a shorter type of platform may be used at the surface

→ इस कारण से platform use करते हैं।

→ Tilting platform → swinging rails से बना होता है and steel plates से covered रहता है।

tongued rails लगे होते



- इस कारण से platform use करते हैं।
- Tilting platform → swinging rails से बना होता है and steel plates से covered रहता है।
- Platform के front end में tongued rails लगे होते हैं जिससे descending cage नीचे push करता है and ascending cage ऊपर Push करता है।

- cage के दोनों entrance पर एक-एक Platform होता है जिसे compressed air से operate किया जाता है।
- Long tilting Platform → जब difference 15cm से अधिक हो

difference → Lowest level on loading side & highest level on Unloading side.

- winding rope के stretch का effect pit bottom में अधिक होता है & Pit top में कम होता ↳ short tilting platform.

Guides used in mine shafts

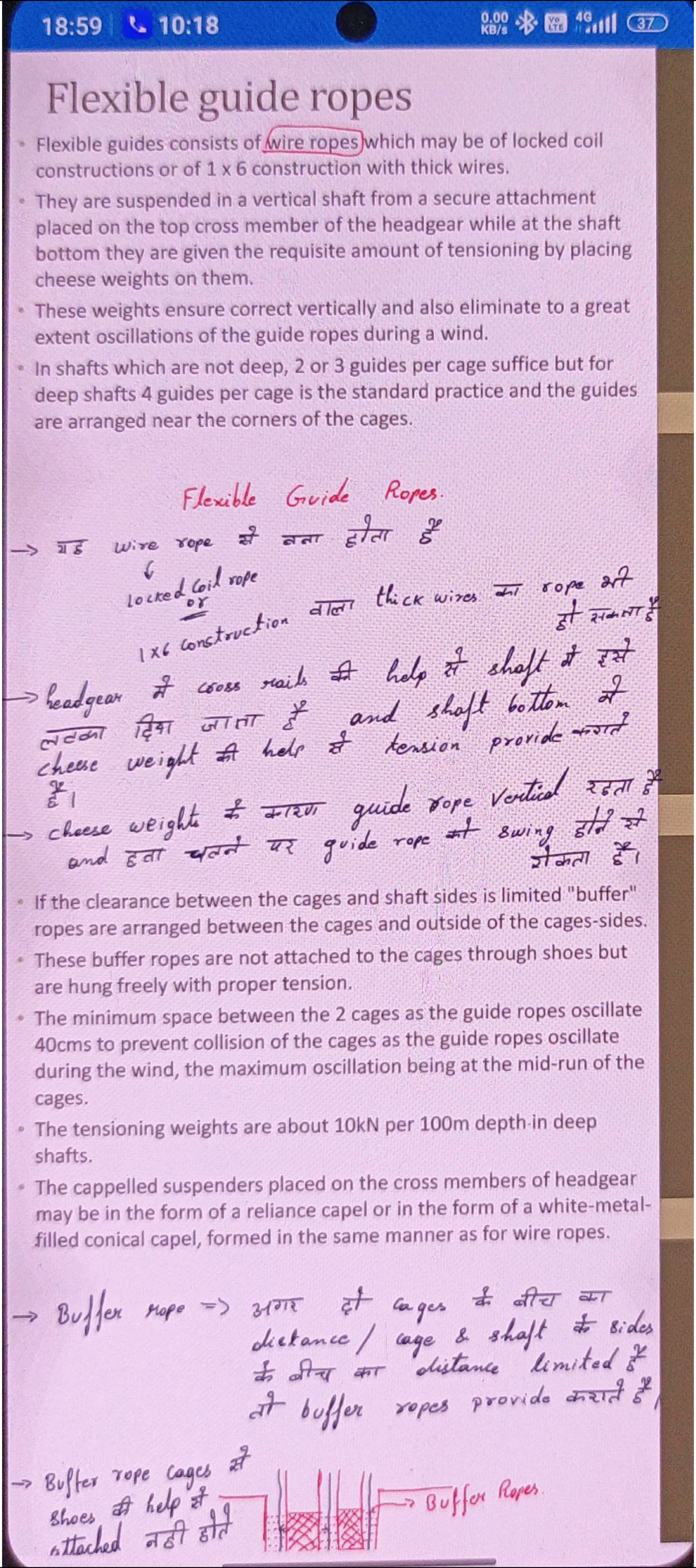
- The guides used in mine shafts are:-
  - ✓Rigid guides
  - ✓Flexible guides or rope guides
- Rigid guides are of hard wood or steel (rail section).
- They are of rectangular cross-section, usually 10 cm x20 cm, and are fixed by countersunk bolts to the buntons placed across the shaft at intervals of 1.8 m 3 m.
- They suffer from the risk of fire.

Flexible guide ropes

Flexible guides consists of wire ropes which may be of locked coil constructions or of 1 x 6 construction with thick wires.

They are suspended in a vertical shaft from a secure attachment placed on the top cross member of the headgear while at the shaft bottom they are given the requisite amount of tensioning by placing cheese weights on them.

These weights ensure correct vertically and also eliminate to a great extent oscillations of the guide ropes during a wind.



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- These weights ensure correct vertically and also eliminate to a great extent oscillations of the guide ropes during a wind.
- In shafts which are not deep, 2 or 3 guides per cage suffice but for deep shafts 4 guides per cage is the standard practice and the guides are arranged near the corners of the cages.

Flexible Guide Ropes.

→ यह wire rope से बना होता है
↓
locked coil rope
or
1x6 construction वाला thick wires का rope भी हो सकता है

→ headgear मे cross rails की help से shaft मे इसे लटका दिया जाता है and shaft bottom मे cheese weight की help से tension provide कराते है।

→ cheese weight के कारण guide rope vertical रहता है and हवा चलने पर guide rope को swing होने से रोकता है।

- If the clearance between the cages and shaft sides is limited "buffer" ropes are arranged between the cages and outside of the cages-sides.
- These buffer ropes are not attached to the cages through shoes but are hung freely with proper tension.
- The minimum space between the 2 cages as the guide ropes oscillate 40cms to prevent collision of the cages as the guide ropes oscillate during the wind, the maximum oscillation being at the mid-run of the cages.
- The tensioning weights are about 10kN per 100m depth in deep shafts.
- The cappelled suspenders placed on the cross members of headgear may be in the form of a reliance capel or in the form of a white-metal-filled conical capel, formed in the same manner as for wire ropes.

→ Buffer rope => अगर दो cages के बीच का distance / cage & shaft के sides के बीच का distance limited है तो buffer ropes provide कराते है।

→ Buffer rope cages से shoes की help से attached नही होते

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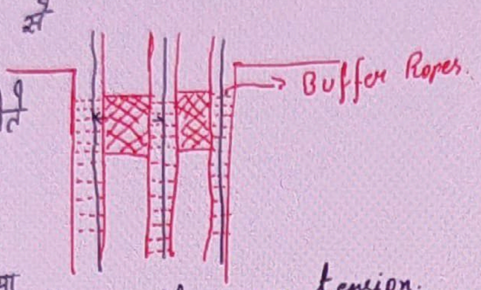


→ Buffer rope cages से shoes की help से attached नही होते है।

→ Buffer rope को freely hang किया जाता है with proper tension.

- Rigid guides require a shaft truly vertical and perfect alignment of the guides is essential.
- As oscillations of cages are non-existent, there is no risk of collision of cages, shafts need not be roomy and guides can be fitted in shafts of limited size, permitting practically entire cross-section, nearly 80 %, to be used by the cage/skip.
- The rope guides are cheap, easy to install and do not require frequent attention to maintenance.
- Buntons throughout the shaft at intervals are not required.
- Flexible guides provide a smooth run for the cages compared to the rigid guides.

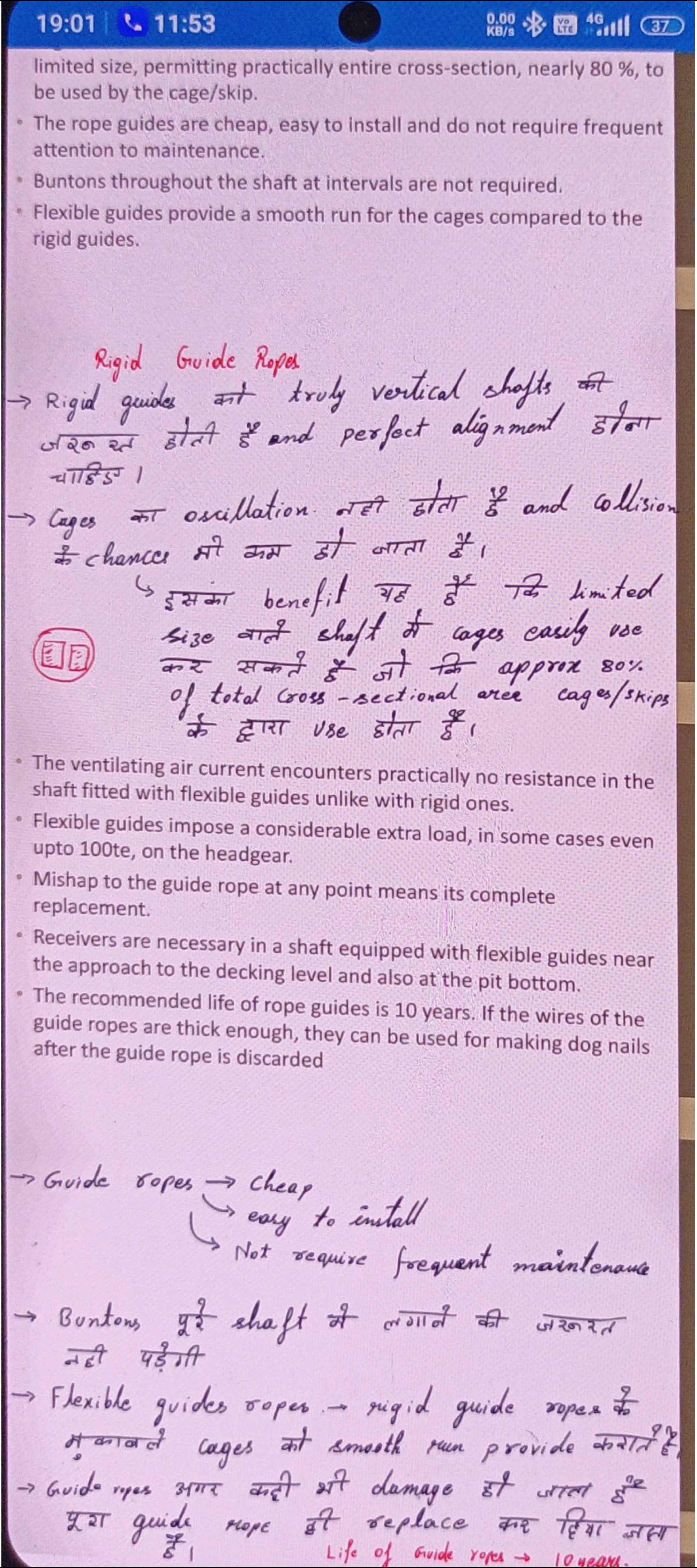
Rigid Guide Ropes

→ Rigid guides को truly vertical shafts की जरुरत होती है and perfect alignment होना चाहिए।

→ Cages का oscillation नही होता है and collision के chances भी कम हो जाता है।

↳ इसका benefit यह है कि limited size वाले shaft मे cages easily use कर सकते है जो कि approx 80% of total cross-sectional area cages/skips के द्वारा use होता है।

- The ventilating air current encounters practically no resistance in the shaft fitted with flexible guides unlike with rigid ones.
- Flexible guides impose a considerable extra load, in some cases even upto 100te, on the headgear.
- Mishap to the guide rope at any point means its complete replacement.
- Receivers are necessary in a shaft equipped with flexible guides near the approach to the decking level and also at the pit bottom.
- The recommended life of rope guides is 10 years. If the wires of the guide ropes are thick enough, they can be used for making dog nails



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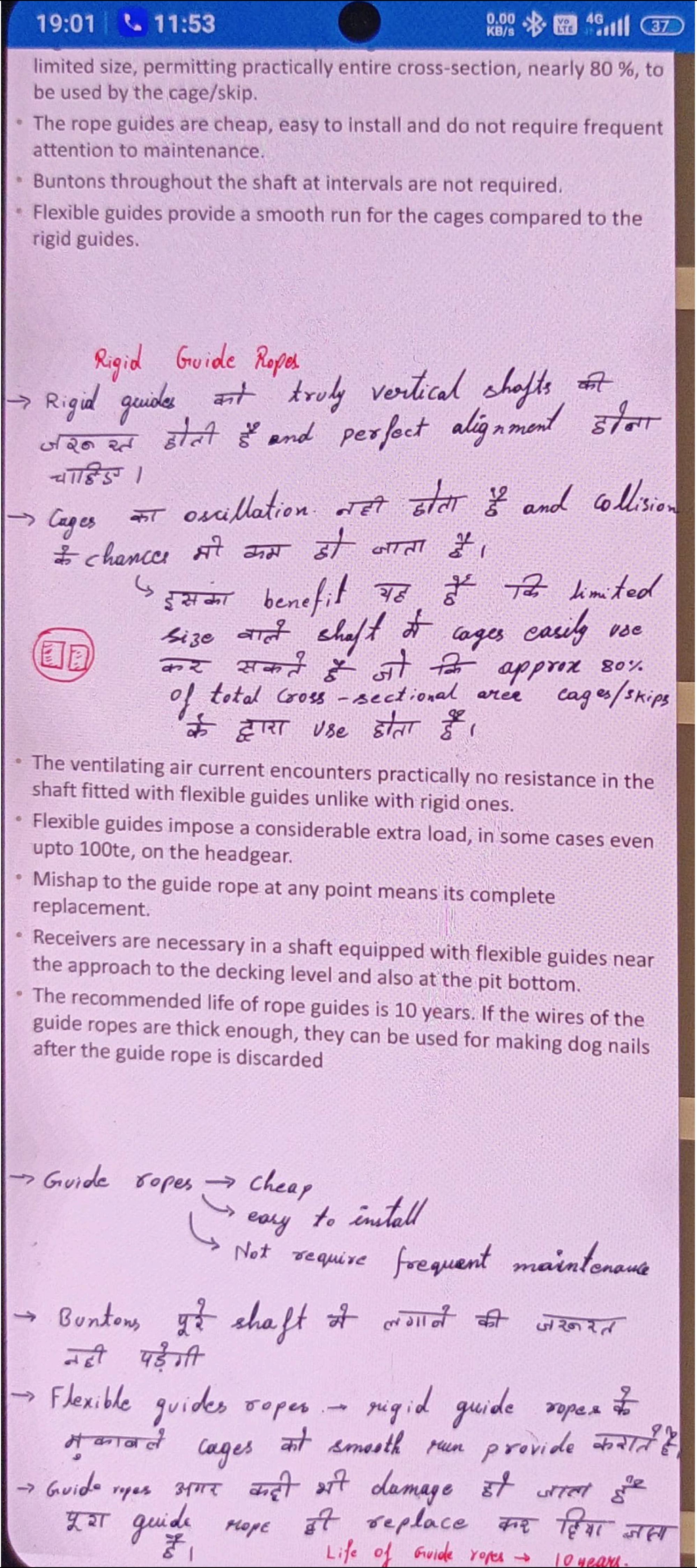
→ Guide ropes → cheap
↳ easy to install
↳ Not require frequent maintenance

→ Buntons पूरे shaft में लगाने की जरूरत नहीं पड़ेगी

→ Flexible guides ropes → rigid guide ropes के मुकाबले cages को smooth run provide कराते है।

→ Guide ropes अगर कही भी damage हो जाता है पूरा guide rope ही replace कर दिया जाता है।

Life of Guide ropes → 10 years.



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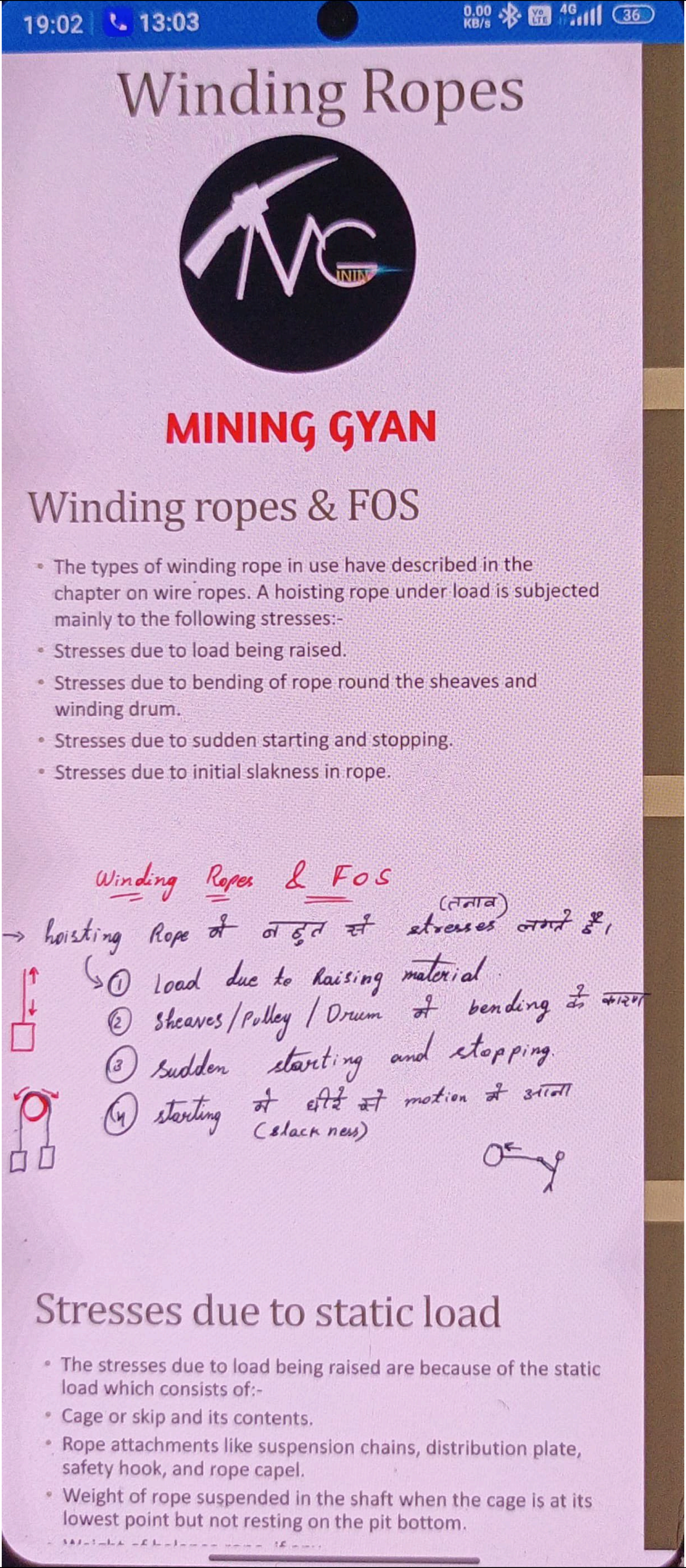
→ Buntons पूरे shaft में लगाने की जरूरत नहीं पड़ेगी

→ Flexible guides ropes → rigid guide ropes के मुकाबले cages को smooth run provide कराते हैं।

→ Guide ropes अगर कहीं भी damage हो जाता है पूरा guide rope ही replace कर दिया जाता है।

Life of Guide ropes → 10 years.



Winding Ropes

MINING GYAN

Winding ropes & FOS

- The types of winding rope in use have described in the chapter on wire ropes. A hoisting rope under load is subjected mainly to the following stresses:-
- Stresses due to load being raised.
- Stresses due to bending of rope round the sheaves and winding drum.
- Stresses due to sudden starting and stopping.
- Stresses due to initial slakness in rope.

Winding Ropes & FOS

→ hoisting Rope में बहुत से stresses (तनाव) लगते हैं।

↳ ① Load due to Raising material.

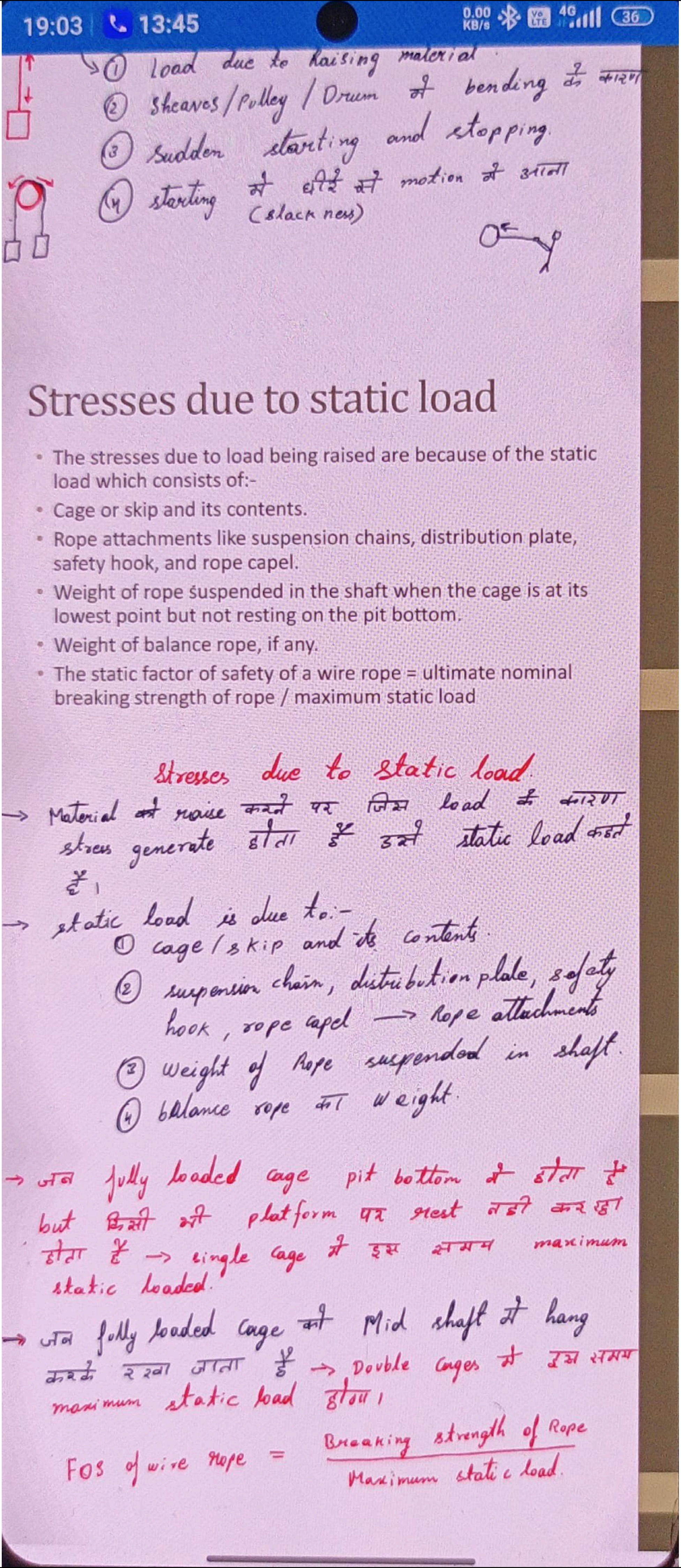
② Sheaves/Pulley / Drum में bending के कारण

③ Sudden starting and stopping.

④ starting में धीरे से motion में आना (slackness)

Stresses due to static load

- The stresses due to load being raised are because of the static load which consists of:-
- Cage or skip and its contents.
- Rope attachments like suspension chains, distribution plate, safety hook, and rope capel.
- Weight of rope suspended in the shaft when the cage is at its lowest point but not resting on the pit bottom.
- Weight of balance rope, if any.



① Load due to Raising material.
② Sheaves/Pulley / Drum मे bending के कारण
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- Weight of rope suspended in the shaft when the cage is at its lowest point but not resting on the pit bottom.
- Weight of balance rope, if any.
- The static factor of safety of a wire rope = ultimate nominal breaking strength of rope / maximum static load

Stresses due to Static load.

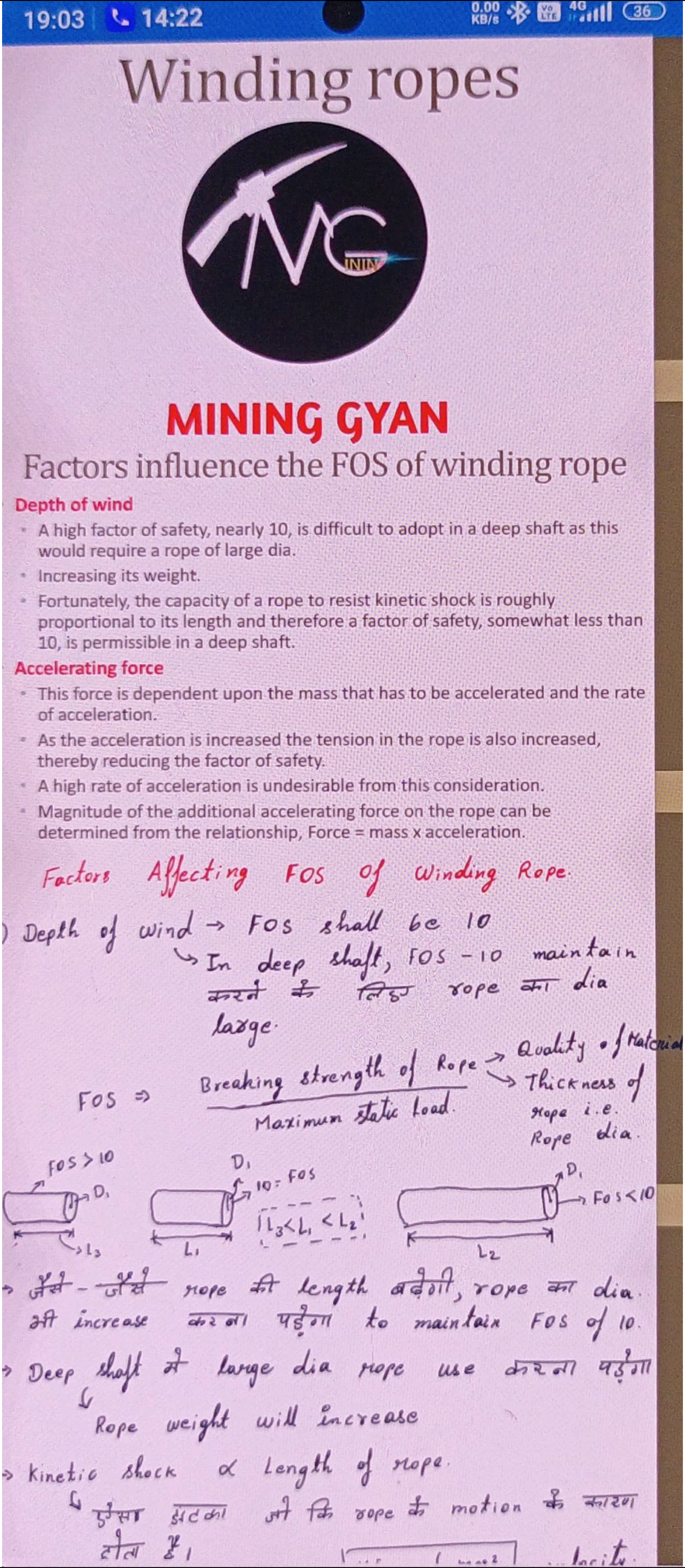
→ Material को raise करने पर जिस load के कारण stress generate होता है उसे static load कहते है।

→ static load is due to:-
① cage / skip and its contents.
② suspension chain, distribution plate, safety hook, rope capel → Rope attachments
③ weight of Rope suspended in shaft.
④ balance rope का weight.

→ जब fully loaded cage pit bottom मे होता है but किसी भी platform पर rest नही कर रहा होता है → single cage मे इस समय maximum static loaded.

→ जब fully loaded cage को Mid shaft मे hang करके रखा जाता है → Double cages मे इस समय maximum static load होगा।

$$\text{FOS of wire Rope} = \frac{\text{Breaking strength of Rope}}{\text{Maximum static load.}}$$



Winding ropes

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Factors influence the FOS of winding rope

Depth of wind

- A high factor of safety, nearly 10, is difficult to adopt in a deep shaft as this would require a rope of large dia.
- Increasing its weight.
- Fortunately, the capacity of a rope to resist kinetic shock is roughly proportional to its length and therefore a factor of safety, somewhat less than 10, is permissible in a deep shaft.

Accelerating force

- This force is dependent upon the mass that has to be accelerated and the rate of acceleration.
- As the acceleration is increased the tension in the rope is also increased, thereby reducing the factor of safety.
- A high rate of acceleration is undesirable from this consideration.
- Magnitude of the additional accelerating force on the rope can be determined from the relationship, Force = mass x acceleration.

Factors Affecting FOS of Winding Rope.

) Depth of wind → FOS shall be 10
↳ In deep shaft, FOS - 10 maintain करने के लिए rope का dia large.

$$\text{FOS} \Rightarrow \frac{\text{Breaking strength of Rope}}{\text{Maximum static load}}$$

Breaking strength of Rope → Quality of Material
→ Thickness of rope i.e. Rope dia.

→ जैसे - जैसे rope की length बढ़ेगी, rope का dia भी increase करना पड़ेगा to maintain FOS of 10.

→ Deep shaft मे large dia rope use करना पड़ेगा
↳ Rope weight will increase

→ Kinetic shock ∝ Length of rope.
↳ ऐसा झटका जो कि rope के motion के कारण होता है।

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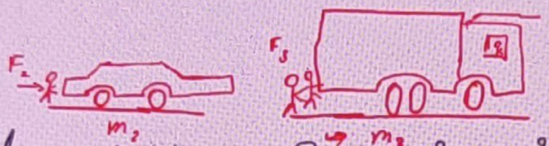
↳ ऐसा झटका जो कि rope के motion के कारण होता है।

$\boxed{KE = \frac{1}{2} m v^2}$ → velocity
↓ mass

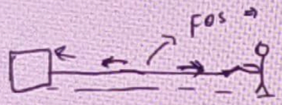
→ Kinetic shock अधिक ना हो
इसलिए deep shaft में 10 से कम FoS वाले Ropes भी Permissible है।

② Accelerating force ⇒ यह एक ऐसा force है जो कि उस body के mass पर depend करेगा जिसे accelerate करना है।

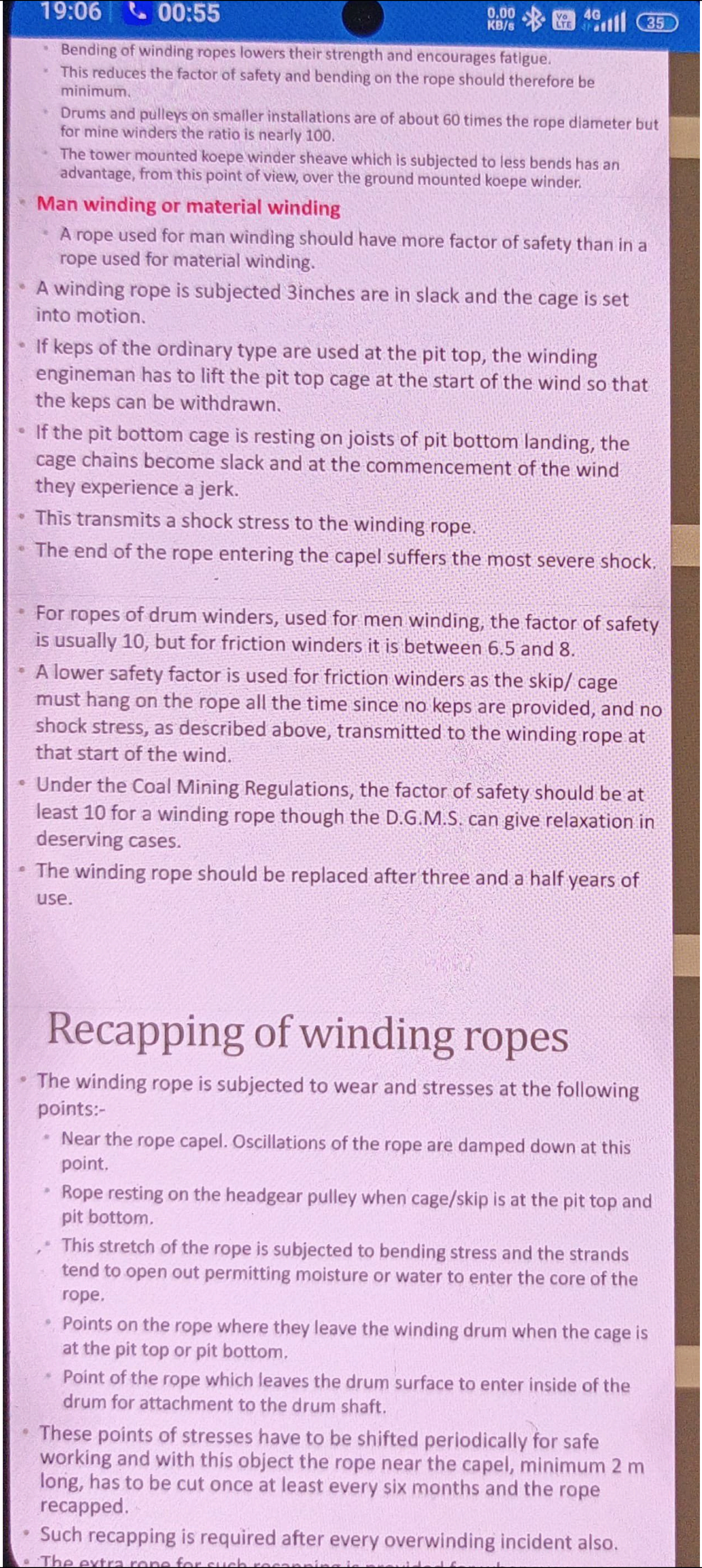


⇒ अगर mass and acceleration अधिक होगा तो winding rope में Tension create होगा

⇒ Force = Mass × accelation



- **Type of construction of rope**
  - For a given diameter of rope a locked coil rope is stronger than a stranded rope with fibre core.
  - It may, therefore, be sometimes necessary to use a locked coil rope to avoid a large diameter stranded rope if existing headgear pulleys, winding drums, etc. have to be used for a deep shaft.
- **Conditions under which rope is used and the period of use**
  - A winding rope which has been used for some time has obviously a lower factor of safety than a newly installed rope.
  - A rope in an upcast shaft which normally has higher moisture content and higher temperature compared to a DC shaft has a low factor of safety.
- **Bending of ropes**
  - Bending of winding ropes lowers their strength and encourages fatigue.
  - This reduces the factor of safety and bending on the rope should therefore be minimum.
  - Drums and pulleys on smaller installations are of about 60 times the rope diameter but for mine winders the ratio is nearly 100.
  - The tower mounted koepe winder sheave which is subjected to less bends has an advantage, from this point of view, over the ground mounted koepe winder.
- **Man winding or material winding**
  - A rope used for man winding should have more factor of safety than in a rope used for material winding.
- A winding rope is subjected 3inches are in slack and the cage is set into motion.
- If keps of the ordinary type are used at the pit top, the winding engineman has to lift the pit top cage at the start of the wind so that the keps can be withdrawn.
- If the pit bottom cage is resting on joists of pit bottom landing, the cage chains become slack and at the commencement of the wind they experience a jerk.
- This transmits a shock stress to the winding rope.
- The end of the rope entering the capel suffers the most severe shock.



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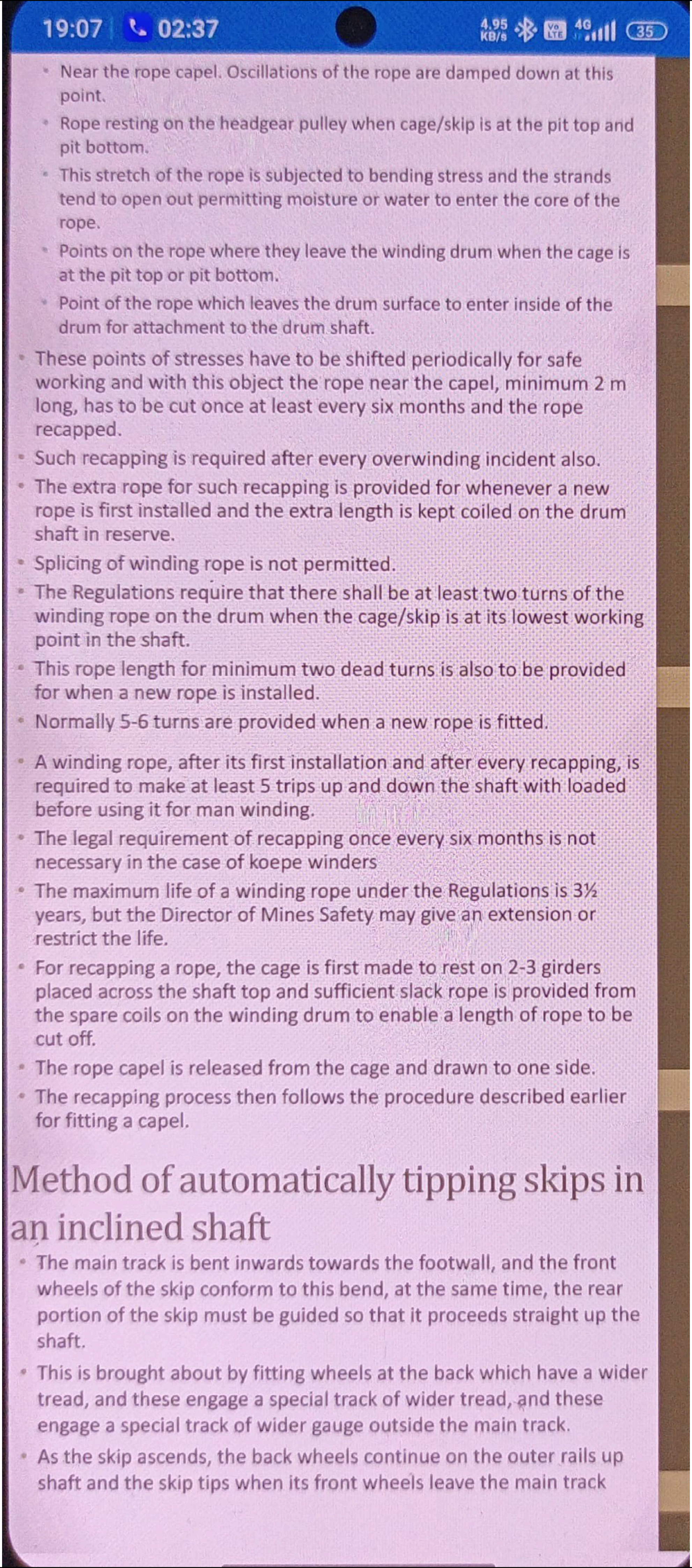
- The end of the rope entering the capel suffers the most severe shock.

- For ropes of drum winders, used for men winding, the factor of safety is usually 10, but for friction winders it is between 6.5 and 8.
- A lower safety factor is used for friction winders as the skip/ cage must hang on the rope all the time since no keps are provided, and no shock stress, as described above, transmitted to the winding rope at that start of the wind.
- Under the Coal Mining Regulations, the factor of safety should be at least 10 for a winding rope though the D.G.M.S. can give relaxation in deserving cases.
- The winding rope should be replaced after three and a half years of use.

Recapping of winding ropes

- The winding rope is subjected to wear and stresses at the following points:-
  - Near the rope capel. Oscillations of the rope are damped down at this point.
  - Rope resting on the headgear pulley when cage/skip is at the pit top and pit bottom.
  - This stretch of the rope is subjected to bending stress and the strands tend to open out permitting moisture or water to enter the core of the rope.
  - Points on the rope where they leave the winding drum when the cage is at the pit top or pit bottom.
  - Point of the rope which leaves the drum surface to enter inside of the drum for attachment to the drum shaft.
- These points of stresses have to be shifted periodically for safe working and with this object the rope near the capel, minimum 2 m long, has to be cut once at least every six months and the rope recapped.
- Such recapping is required after every overwinding incident also.
- The extra rope for such recapping is provided f



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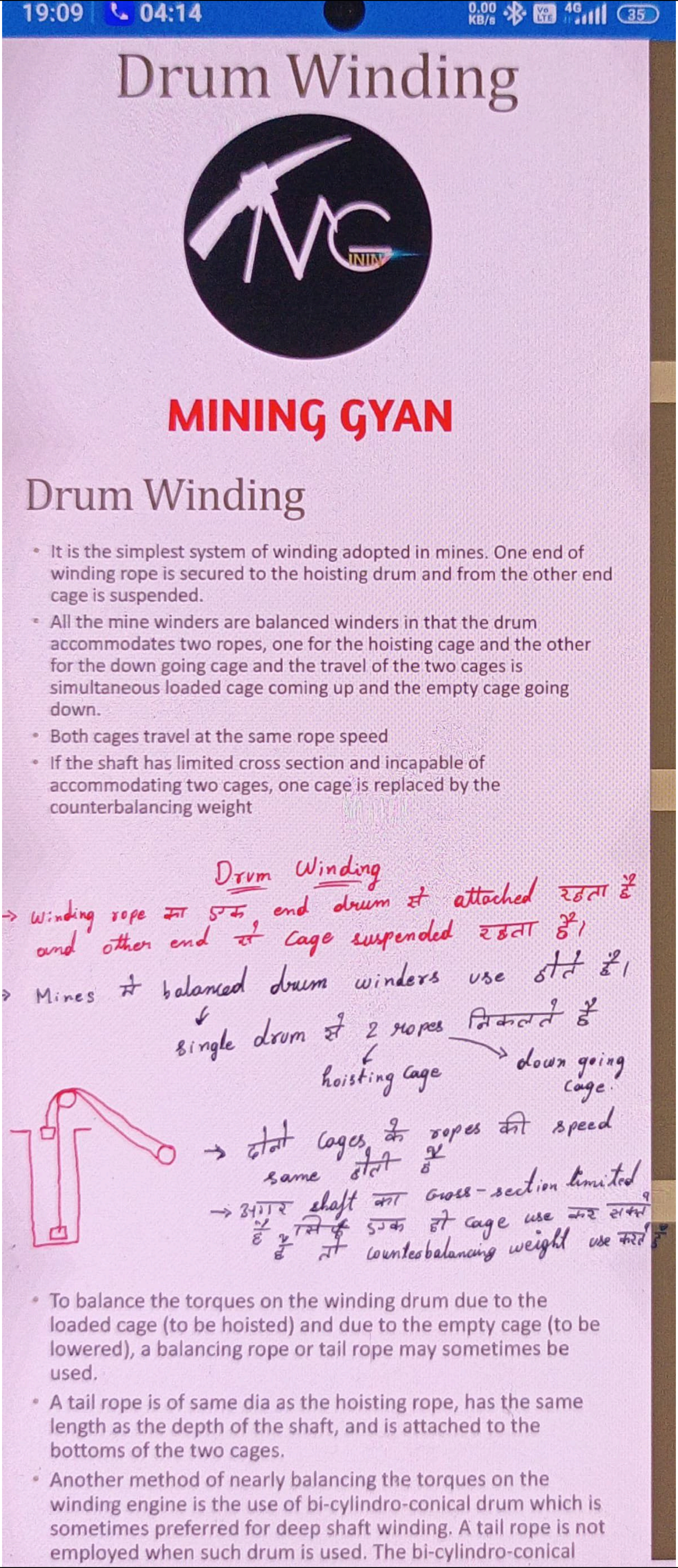
- Such recapping is required after every overwinding incident also.
- The extra rope for such recapping is provided for whenever a new rope is first installed and the extra length is kept coiled on the drum shaft in reserve.
- Splicing of winding rope is not permitted.
- The Regulations require that there shall be at least two turns of the winding rope on the drum when the cage/skip is at its lowest working point in the shaft.
- This rope length for minimum two dead turns is also to be provided for when a new rope is installed.
- Normally 5-6 turns are provided when a new rope is fitted.
- A winding rope, after its first installation and after every recapping, is required to make at least 5 trips up and down the shaft with loaded before using it for man winding.
- The legal requirement of recapping once every six months is not necessary in the case of koepe winders
- The maximum life of a winding rope under the Regulations is 3½ years, but the Director of Mines Safety may give an extension or restrict the life.
- For recapping a rope, the cage is first made to rest on 2-3 girders placed across the shaft top and sufficient slack rope is provided from the spare coils on the winding drum to enable a length of rope to be cut off.
- The rope capel is released from the cage and drawn to one side.
- The recapping process then follows the procedure described earlier for fitting a capel.

Method of automatically tipping skips in an inclined shaft

- The main track is bent inwards towards the footwall, and the front wheels of the skip conform to this bend, at the same time, the rear portion of the skip must be guided so that it proceeds straight up the shaft.
- This is brought about by fitting wheels at the back which have a wider tread, and these engage a special track of wider tread, and these engage a special track of wider gauge outside the main track.
- As the skip ascends, the back wheels continue on the outer rails up shaft and the skip tips when its front wheels leave the main track



Drum Winding

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Drum Winding

- It is the simplest system of winding adopted in mines. One end of winding rope is secured to the hoisting drum and from the other end cage is suspended.
- All the mine winders are balanced winders in that the drum accommodates two ropes, one for the hoisting cage and the other for the down going cage and the travel of the two cages is simultaneous loaded cage coming up and the empty cage going down.
- Both cages travel at the same rope speed
- If the shaft has limited cross section and incapable of accommodating two cages, one cage is replaced by the counterbalancing weight

Drum Winding

→ Winding rope का एक end drum से attached रहता है and other end से cage suspended रहता है।

→ Mines में balanced drum winders use होते हैं।

↓

single drum से 2 ropes निकलते हैं

↙ hoisting cage

→ down going cage.

→ दोनों cages के ropes की speed same होती है

→ अगर shaft का cross-section limited है, जिससे एक ही cage use कर सकते हैं तो counterbalancing weight use करते हैं

- To balance the torques on the winding drum due to the loaded cage (to be hoisted) and due to the empty cage (to be lowered), a balancing rope or tail rope may sometimes be used.
- A tail rope is of same dia as the hoisting rope, has the same length as the depth of the shaft, and is attached to the bottoms of the two cages.
- Another method of nearly balancing the torques on the winding engine is the use of bi-cylindro-conical drum which is sometimes preferred for deep shaft winding. A tail rope is not employed when such drum is used. The bi-cylindro-conical

used.

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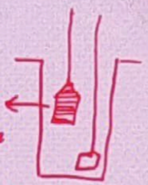
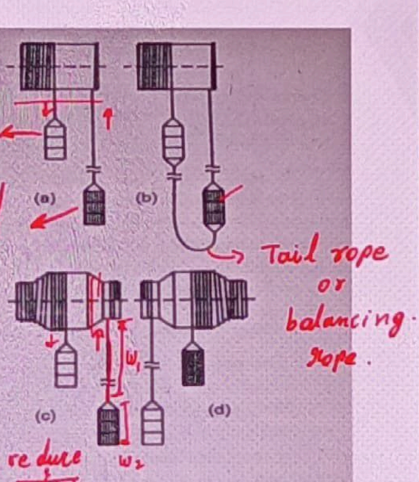
- Another method of nearly balancing the torques on the winding engine is the use of bi-cylindro-conical drum which is sometimes preferred for deep shaft winding. A tail rope is not employed when such drum is used. The bi-cylindro-conical drum is larger than the cylindrical drum for the same duty and is so constructed that there are 3 drums on the same shaft.

→ loaded & empty cage के कारण winding drum को balance रखने के लिए balancing rope / tail rope का use करते है।



→ tail rope का dia hoisting rope के dia के बराबर होता है।
↳ length → equal to shaft depth.
↳ Attached at → cages के bottom में attach करते है।

For balancing
↳ ① Tail rope.
② Bi-Cylindro - Conical drum.

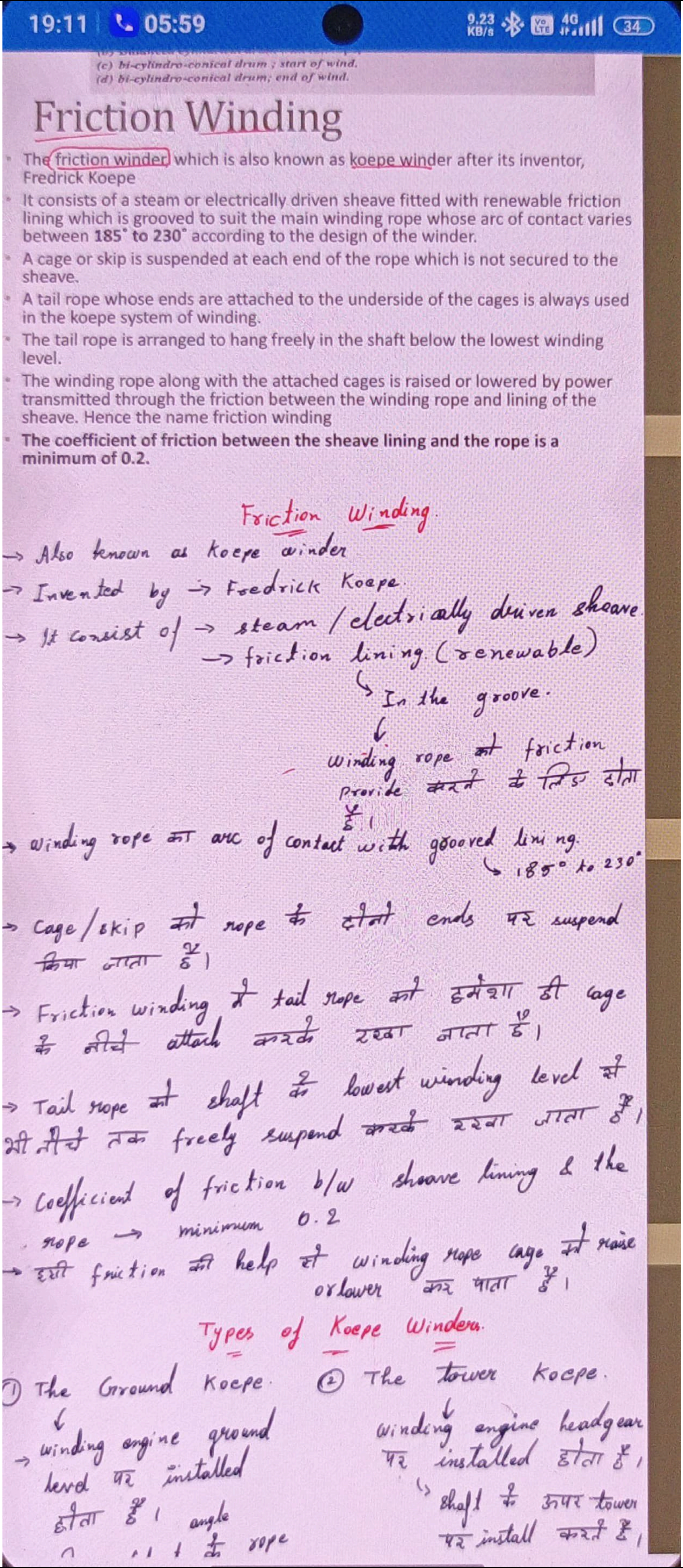


Drum dia increased for loaded cage
↳ एक rotation में ज्यादा लंबी rope को wind करेगा
↳ cage के load को bending reduce करके drum पर shift करेगा

Fig. 12.1 Different systems of drum winding
(a) Balanced cylinder ical drum without tail rope,
(b) Balanced cylindrical drum with tail rope,
(c) bi-cylindro-conical drum ; start of wind.
(d) bi-cylindro-conical drum; end of wind.

Friction Winding

- The friction winder which is also known as koepe winder after its inventor, Fredrick Koepe
- It consists of a steam or electrically driven sheave fitted with renewable friction lining which is grooved to suit the main winding rope whose arc of contact varies between **185° to 230°** according to the design of the winder.
- A cage or skip is suspended at each end of the rope which is not secured to the sheave.
- A tail rope whose ends are attached to the underside of the cages is always used in the koepe system of winding.
- The tail rope is arranged to hang freely in the shaft below the lowest winding level.
- The winding rope along with the attached cages is raised or lowered by power transmitted through the friction between the winding rope and lining of the sheave. Hence the name friction winding
- **The coefficient of friction between the sheave lining and the rope is a minimum of 0.2.**



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Friction Winding.

→ Also known as koepe winder

→ Invented by → Fredrick Koepe.

→ It consist of → steam / electrically driven sheave.
→ friction lining. (renewable)
↳ In the groove.
↓
winding rope को friction provide करने के लिए होता है।

→ winding rope का arc of contact with grooved lining.
↳ 185° to 230°

→ cage / skip को rope के दोनों ends पर suspend किया जाता है।

→ Friction winding में tail rope को हमेशा ही cage के नीचे attach करके रखा जाता है।

→ Tail rope को shaft के lowest winding level से भी नीचे तक freely suspend करके रखा जाता है।

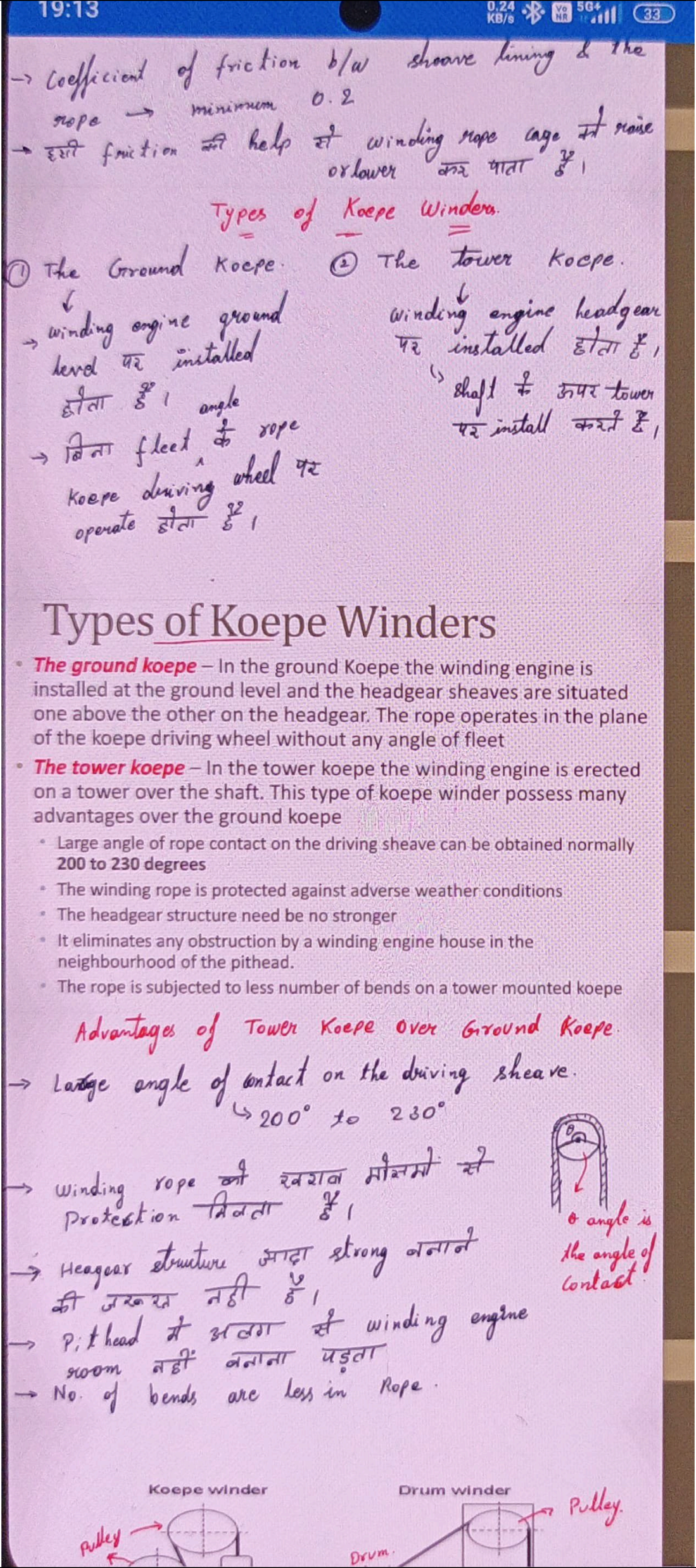
→ Coefficient of friction b/w sheave lining & the rope → minimum 0.2

→ इसी friction की help से winding rope cage को raise or lower कर पाता है।

Types of Koepe Winders.

① The Ground Koepe.
↓
→ winding engine ground level पर installed होता है। angle
के rope

② The tower Koepe.
↓
winding engine headgear पर installed होता है।
↳ shaft के ऊपर tower पर install करते है।



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Types of Koepe Winders.

① The Ground Koepe.

↓

→ winding engine ground level पर installed होता है।

→ बिना fleet angle के rope Koepe driving wheel पर operate होता है।

② The tower Koepe.

↓

winding engine headgear पर installed होता है।

↳ shaft के ऊपर tower पर install करते है।

Types of Koepe Winders

- ***The ground koepe*** – In the ground Koepe the winding engine is installed at the ground level and the headgear sheaves are situated one above the other on the headgear. The rope operates in the plane of the koepe driving wheel without any angle of fleet
- ***The tower koepe*** – In the tower koepe the winding engine is erected on a tower over the shaft. This type of koepe winder possess many advantages over the ground koepe
  - Large angle of rope contact on the driving sheave can be obtained normally **200 to 230 degrees**
  - The winding rope is protected against adverse weather conditions
  - The headgear structure need be no stronger
  - It eliminates any obstruction by a winding engine house in the neighbourhood of the pithead.
  - The rope is subjected to less number of bends on a tower mounted koepe

Advantages of Tower Koepe over Ground Koepe.

→ Large angle of contact on the driving sheave.
↳ 200° to 230°

→ Winding rope को खराब मौसमों से Protection मिलता है।

→ Heagear structure ज्यादा strong बनाने की जरूरत नहीं है।

→ Pithead में अलग से winding engine room नहीं बनाना पड़ता

→ No. of bends are less in Rope.

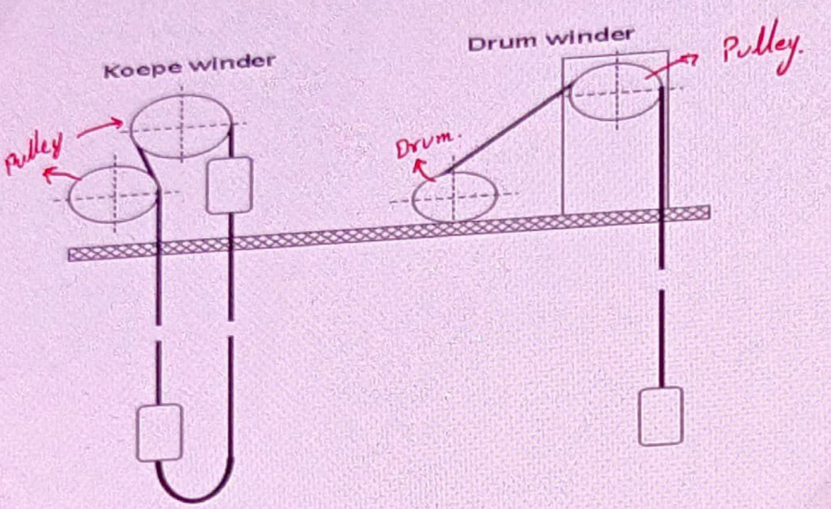
θ angle is the angle of contact.

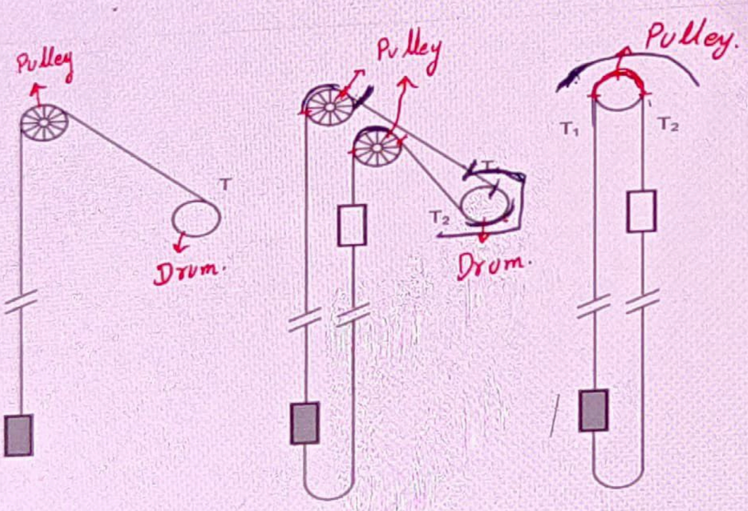
Contact

की जरूरत नही है।

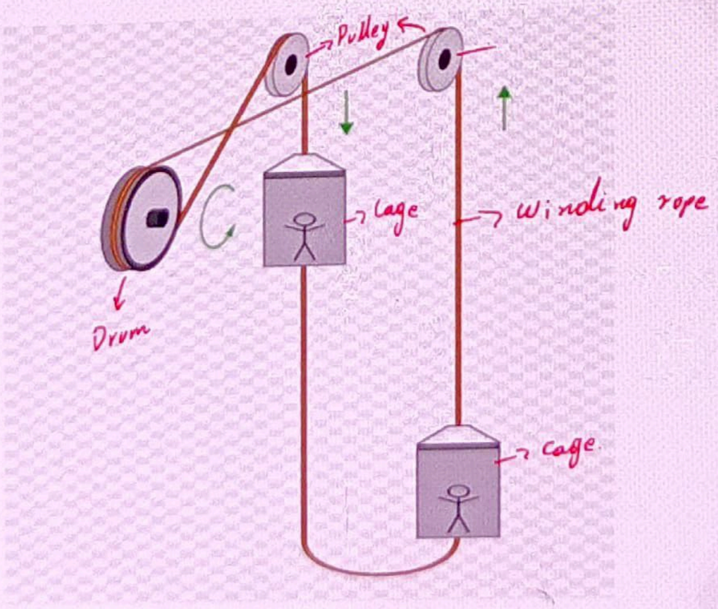
→ Pithead में अलग से winding engine room नहीं बनाना पड़ता

→ No. of bends are less in Rope.


Koepe winder
Drum winder
Pulley
Pulley
Drum.

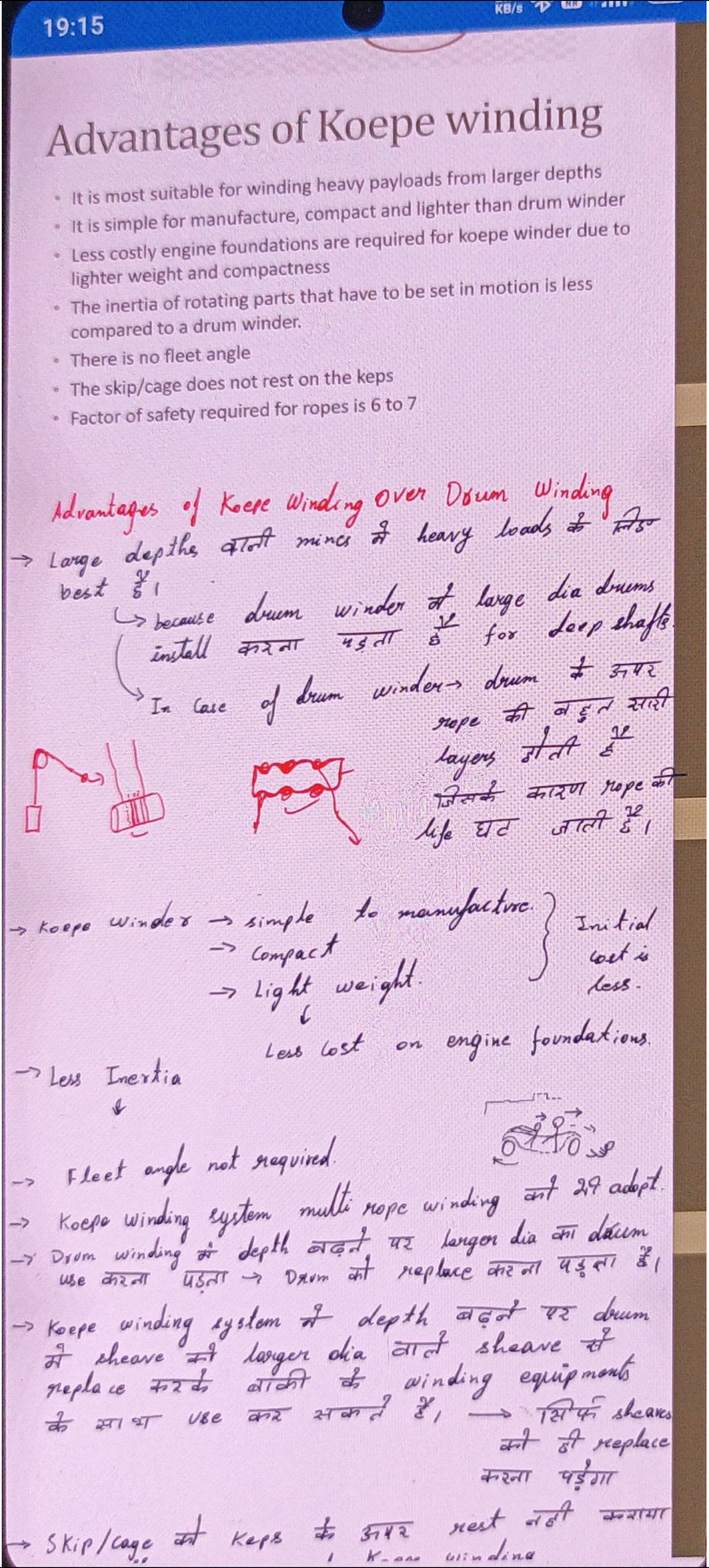

Pulley
T
Drum.
Pulley
T
T₂
Drum.
Pulley.
T₁
T₂

(a) Drum winder (b) Koepe winders: ground mounted (l), tower moun


Pulley
Cage
winding rope
Drum
cage

Advantages of Koepe winding

- It is most suitable for winding heavy payloads from larger depths
- It is simple for manufacture, compact and lighter than drum winder



Advantages of Koepe winding

- It is most suitable for winding heavy payloads from larger depths
- It is simple for manufacture, compact and lighter than drum winder
- Less costly engine foundations are required for koepe winder due to lighter weight and compactness
- The inertia of rotating parts that have to be set in motion is less compared to a drum winder.
- There is no fleet angle
- The skip/cage does not rest on the keps
- Factor of safety required for ropes is 6 to 7

Advantages of Koepe Winding over Drum Winding

→ Large depths वाली mines में heavy loads के लिए best है।

↳ because drum winder में large dia drums install करना पड़ता है for deep shafts.

↳ In case of drum winder → drum के ऊपर rope की बहुत सारी layers होती हैं जिसके कारण rope की life घट जाती है।

→ Koepe winder → simple to manufacture. → Compact → Light weight. } Initial cost is less.

↓ Less cost on engine foundations.

→ Less Inertia

↓

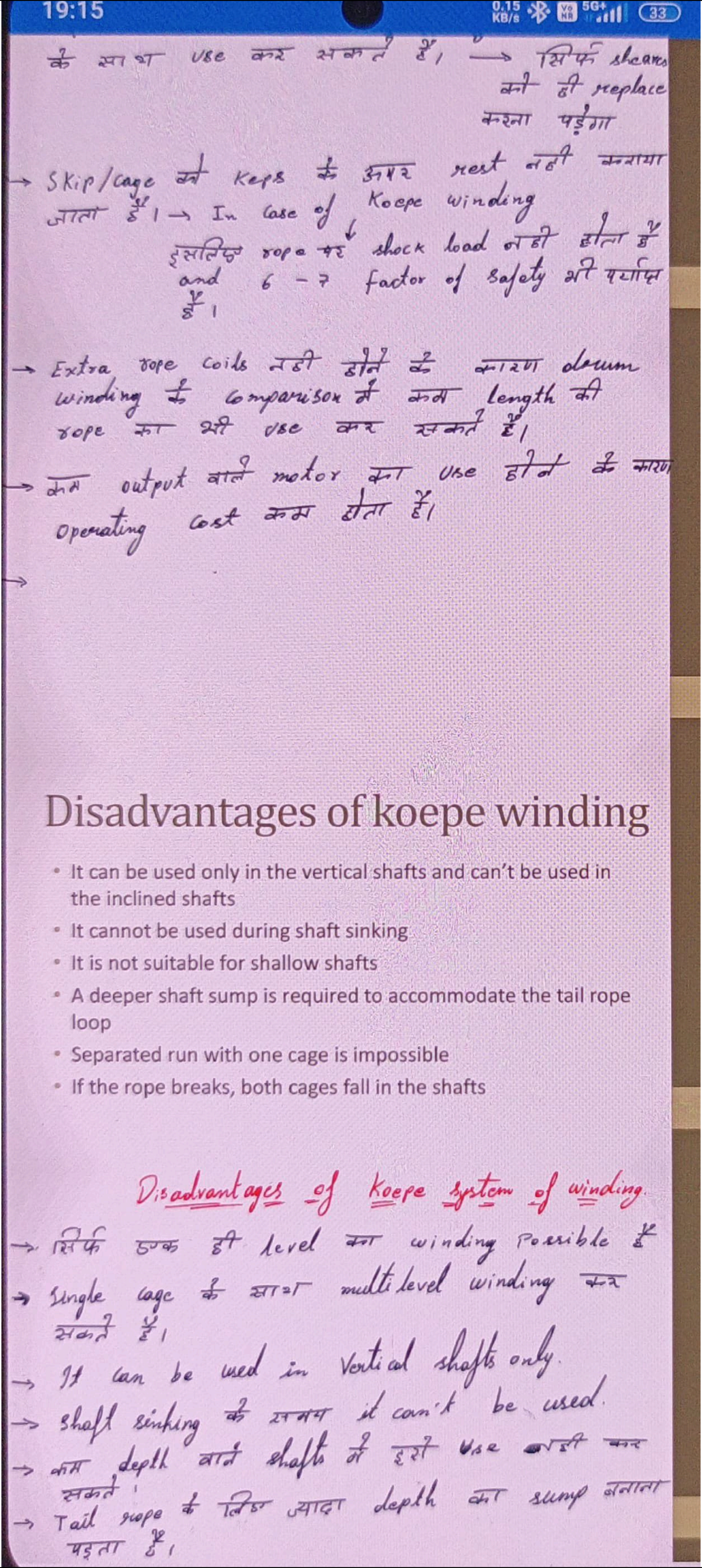
→ Fleet angle not required.

→ Koepe winding system multi rope winding को भी adopt.

→ Drum winding में depth बढ़ने पर larger dia का drum use करना पड़ता → Drum को replace करना पड़ता है।

→ Koepe winding system में depth बढ़ने पर drum में sheave को larger dia वाले sheave से replace करके बाकी के winding equipments के साथ use कर सकते हैं। → सिर्फ sheaves को ही replace करना पड़ेगा

→ Skip/cage को Keps के ऊपर rest नहीं कराया



के साथ use कर सकते हैं। → सिर्फ sheaves को ही replace करना पड़ेगा

→ Skip/cage को Keps के ऊपर rest नहीं कराया जाता है। → In case of Koepe winding ↓
इसलिए rope पर shock load नहीं होता है and 6 - 7 factor of safety भी पर्याप्त है।

→ Extra rope coils नहीं होने के कारण drum winding के comparison में कम length की rope का भी use कर सकते हैं।

→ कम output वाले motor का use होने के कारण Operating cost कम होता है।

→

Disadvantages of koepe winding

- It can be used only in the vertical shafts and can't be used in the inclined shafts
- It cannot be used during shaft sinking
- It is not suitable for shallow shafts
- A deeper shaft sump is required to accommodate the tail rope loop
- Separated run with one cage is impossible
- If the rope breaks, both cages fall in the shafts

Disadvantages of Koepe system of winding.

→ सिर्फ एक ही level का winding Possible है

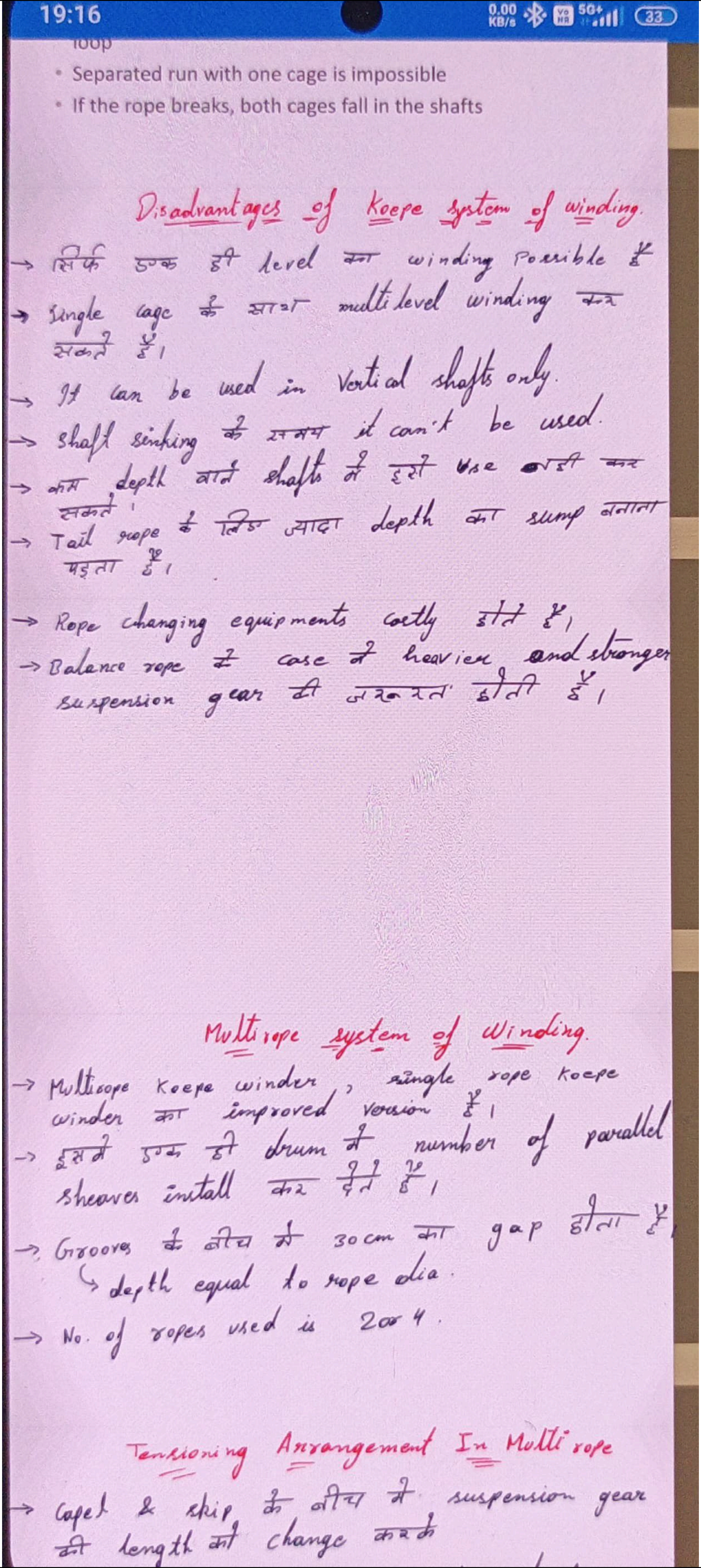
→ Single cage के साथ multilevel winding कर सकते हैं।

→ It can be used in Vertical shafts only.

→ shaft sinking के समय it can't be used.

→ कम depth वाले shafts में इसे use नहीं कर सकते।

→ Tail rope के लिए ज्यादा depth का sump बनाना पड़ता है।



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→ Tail rope के लिए ज्यादा depth का sump बनाना पड़ता है।

→ Rope changing equipments costly होते है।

→ Balance rope के case में heavier and stronger suspension gear की जरूरत होती है।

Multirope system of Winding.

→ Multirope Koepe winder, single rope Koepe winder का improved version है।

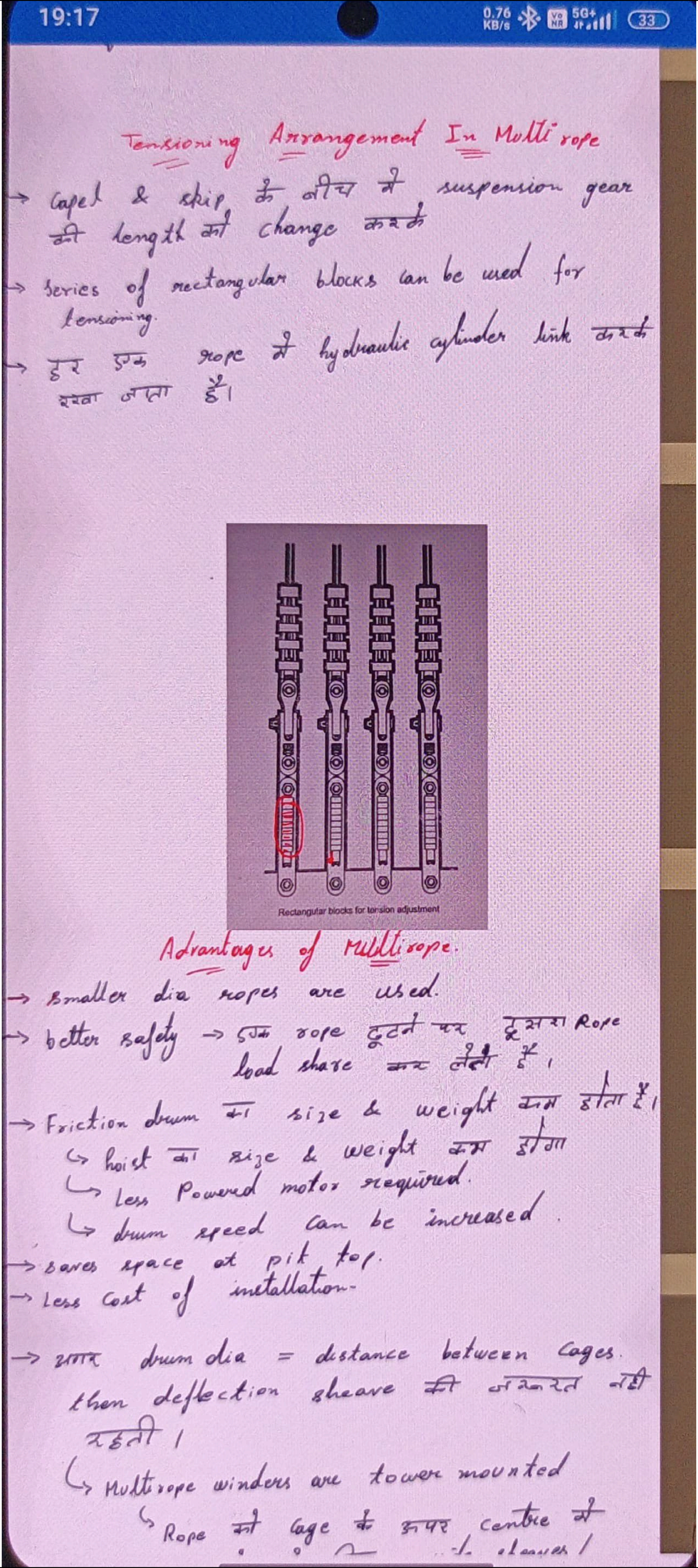
→ इसमें एक ही drum में number of parallel sheaves install कर देते है।

→ Grooves के बीच में 30 cm का gap होता है।
  ↳ depth equal to rope dia.

→ No. of ropes used is 2 or 4.

Tensioning Arrangement In Multirope

→ Cage & skip के बीच में suspension gear की length को change करके



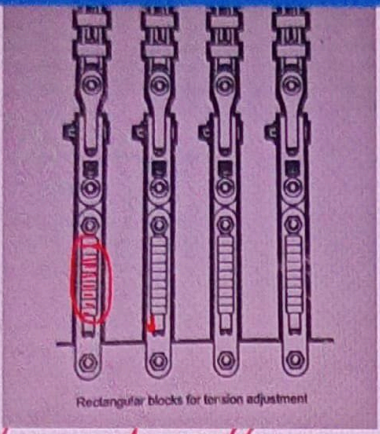
Tensioning Arrangement In Multi rope

- → Cage & skip के नीचे मे suspension gear की length को change करके
- → Series of rectangular blocks can be used for tensioning.
- → हर एक rope मे hydraulic cylinder link करके रखा जाता है।

Rectangular blocks for tension adjustment

Advantages of Multirope.

- → Smaller dia ropes are used.
- → better safety → एक rope टूटने पर दूसरा Rope load share कर लेती है।
- → Friction drum का size & weight कम होता है।
  - ↳ hoist का size & weight कम होगा
  - ↳ Less Powered motor required.
  - ↳ drum speed can be increased.
- → saves space at pit top.
- → Less cost of installation.
- → अगर drum dia = distance between cages then deflection sheave की जरूरत नहीं रहती।
  - ↳ Multirope winders are tower mounted
    - ↳ Rope को cage के ऊपर centre मे



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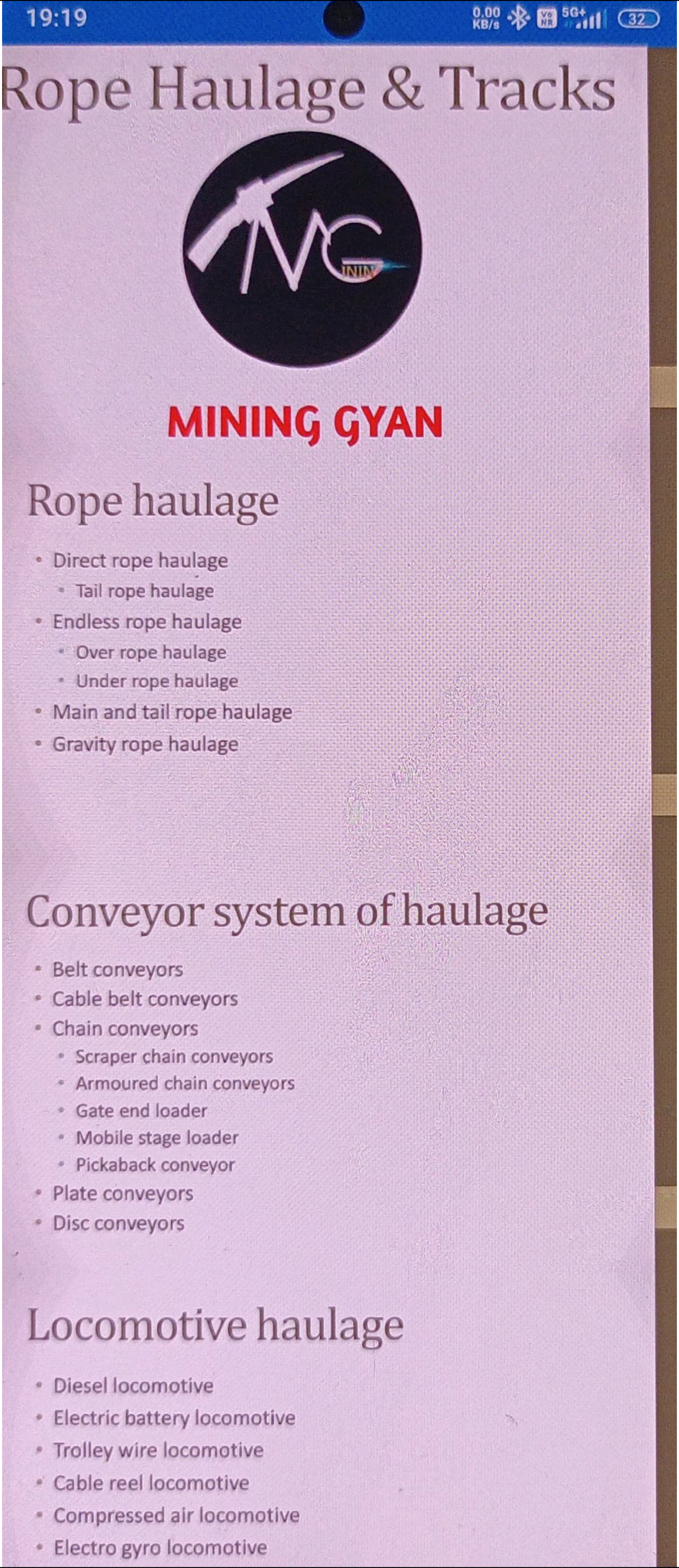
  - ↳ Multirope winders are tower mounted
    - ↳ Rope को cage के ऊपर centre में रखने के लिए guide sheaves / deflection Pulley का use करते है।

Blair Winder

- → अधिक depth वाली mines में single rope को single cage attach करके use करना difficult है।
  - ↳ अधिक dia का rope → size & weight is more.
- → single cage को 2 ropes की help से suspend किया जाता है। → rope & drum dia of reduced size can be used.



Rope Haulage & Tracks

MINING GYAN

Rope haulage

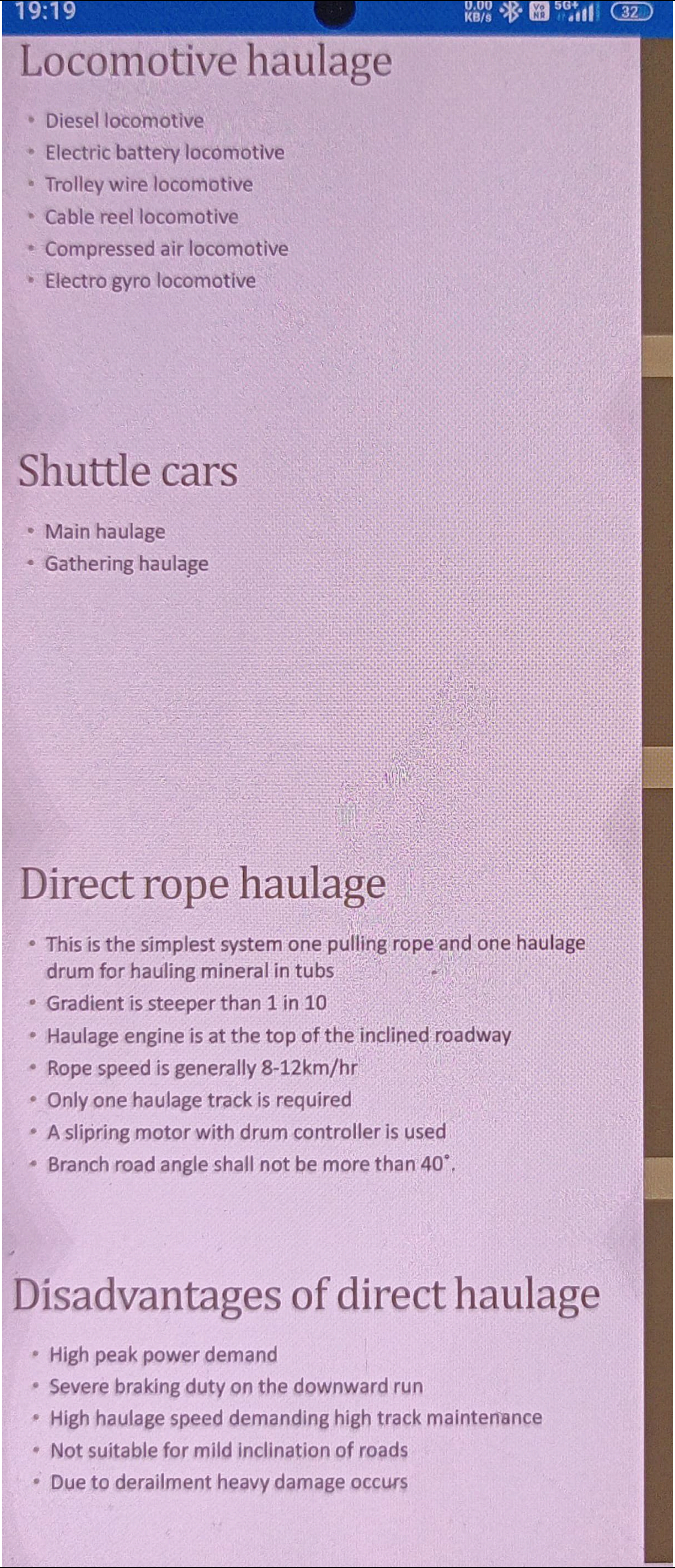
- Direct rope haulage
  - Tail rope haulage
- Endless rope haulage
  - Over rope haulage
  - Under rope haulage
- Main and tail rope haulage
- Gravity rope haulage

Conveyor system of haulage

- Belt conveyors
- Cable belt conveyors
- Chain conveyors
  - Scraper chain conveyors
  - Armoured chain conveyors
  - Gate end loader
  - Mobile stage loader
  - Pickaback conveyor
- Plate conveyors
- Disc conveyors

Locomotive haulage

- Diesel locomotive
- Electric battery locomotive
- Trolley wire locomotive
- Cable reel locomotive
- Compressed air locomotive
- Electro gyro locomotive



Locomotive haulage

- Diesel locomotive
- Electric battery locomotive
- Trolley wire locomotive
- Cable reel locomotive
- Compressed air locomotive
- Electro gyro locomotive

Shuttle cars

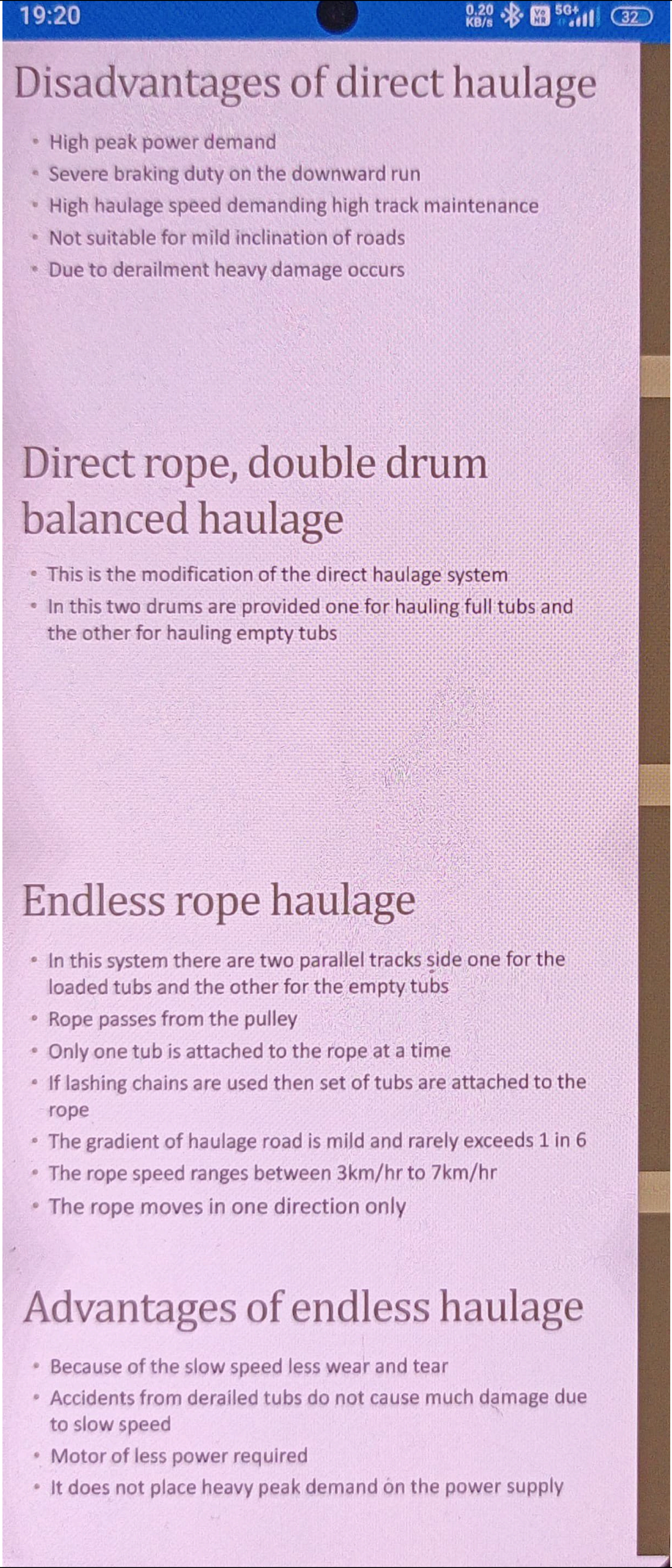
- Main haulage
- Gathering haulage

Direct rope haulage

- This is the simplest system one pulling rope and one haulage drum for hauling mineral in tubs
- Gradient is steeper than 1 in 10
- Haulage engine is at the top of the inclined roadway
- Rope speed is generally 8-12km/hr
- Only one haulage track is required
- A slipring motor with drum controller is used
- Branch road angle shall not be more than 40°.

Disadvantages of direct haulage

- High peak power demand
- Severe braking duty on the downward run
- High haulage speed demanding high track maintenance
- Not suitable for mild inclination of roads
- Due to derailment heavy damage occurs



Disadvantages of direct haulage

- High peak power demand
- Severe braking duty on the downward run
- High haulage speed demanding high track maintenance
- Not suitable for mild inclination of roads
- Due to derailment heavy damage occurs

Direct rope, double drum balanced haulage

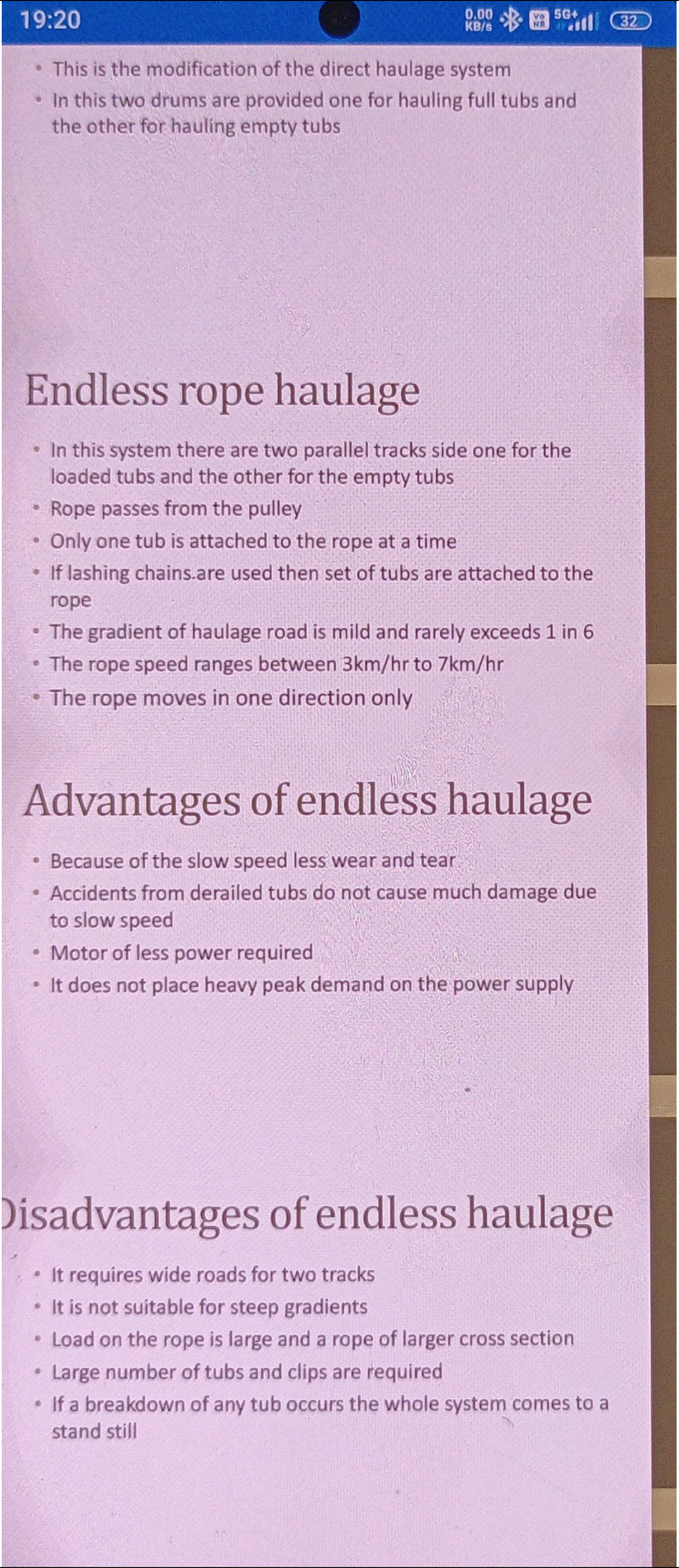
- This is the modification of the direct haulage system
- In this two drums are provided one for hauling full tubs and the other for hauling empty tubs

Endless rope haulage

- In this system there are two parallel tracks side one for the loaded tubs and the other for the empty tubs
- Rope passes from the pulley
- Only one tub is attached to the rope at a time
- If lashing chains are used then set of tubs are attached to the rope
- The gradient of haulage road is mild and rarely exceeds 1 in 6
- The rope speed ranges between 3km/hr to 7km/hr
- The rope moves in one direction only

Advantages of endless haulage

- Because of the slow speed less wear and tear
- Accidents from derailed tubs do not cause much damage due to slow speed
- Motor of less power required
- It does not place heavy peak demand on the power supply



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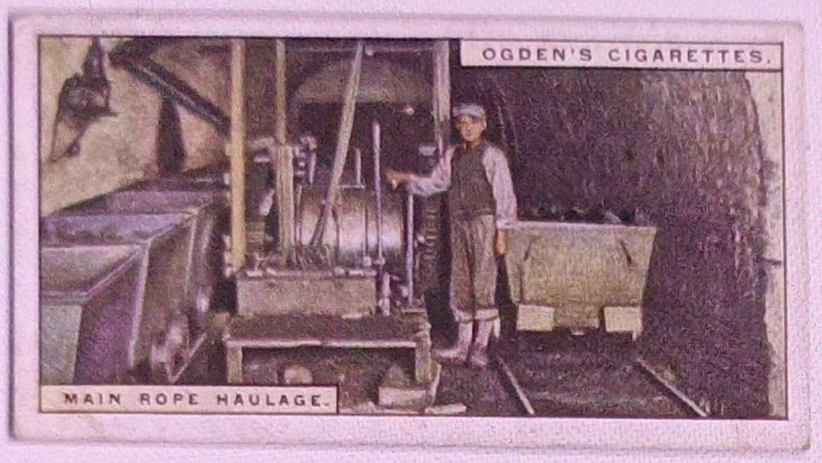
Disadvantages of endless haulage

- It requires wide roads for two tracks
- It is not suitable for steep gradients
- Load on the rope is large and a rope of larger cross section
- Large number of tubs and clips are required
- If a breakdown of any tub occurs the whole system comes to a stand still


OGDEN'S CIGARETTES.
MAIN ROPE HAULAGE.

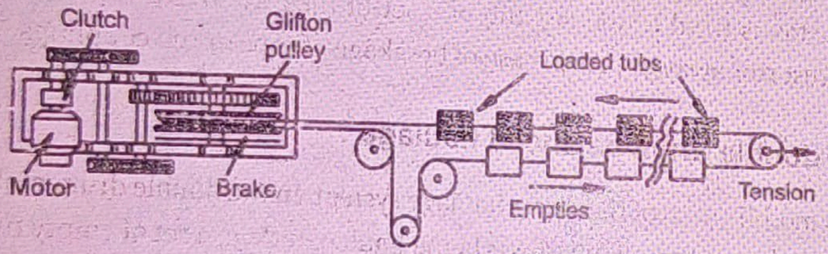

Clutch
Glifton pulley
Loaded tubs
Motor
Brake
Empties
Tension

Fig. 15.2 Endless rope haulage system.

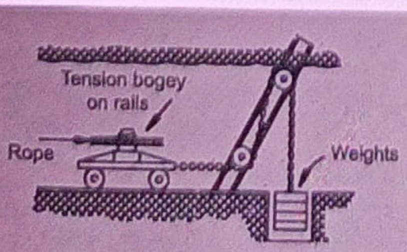
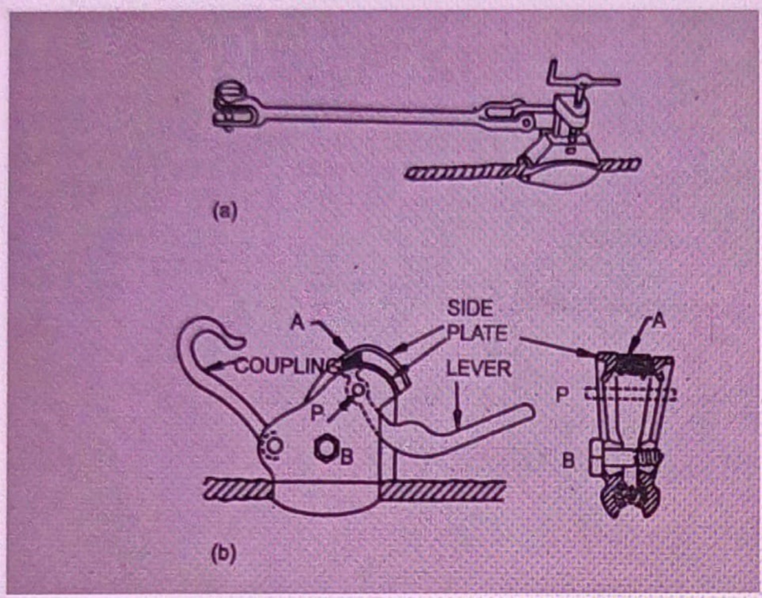

Tension bogey on rails
Rope
Weights

Fig. 15.4 Tension bogey


(a)
A
SIDE PLATE
A
COUPLING
LEVER
P
P
B
B
(b)

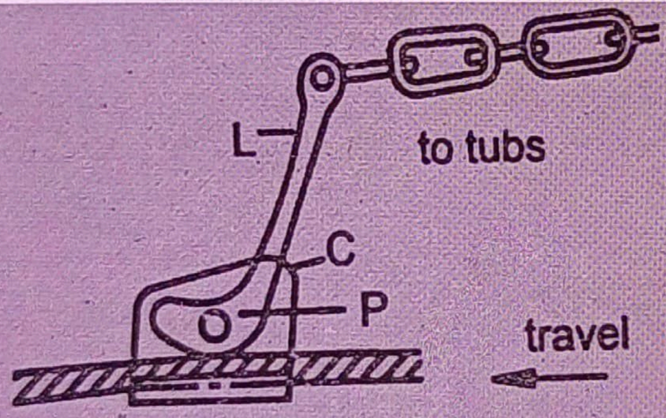
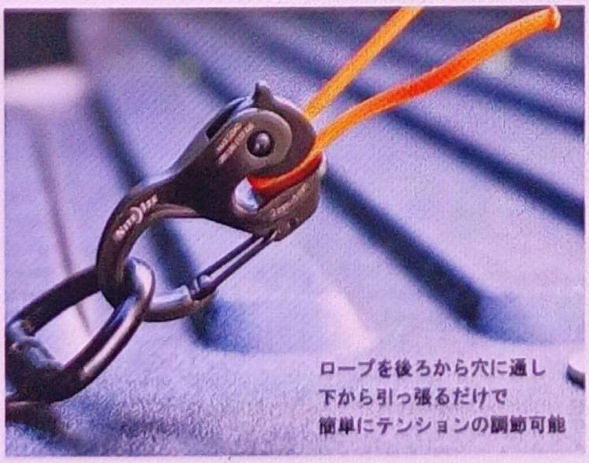

L
to tubs
C
P
travel

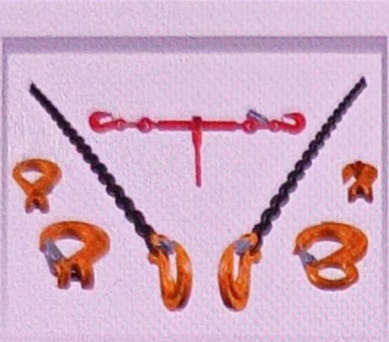
Fig. 15.7 A Cam Clip.

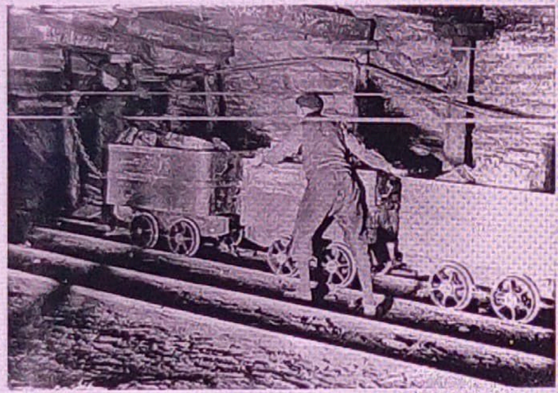
POINT
01

ロープワークが簡単に



ロープを後ろから穴に通し
下から引っ張るだけで
簡単にテンションの調節可能





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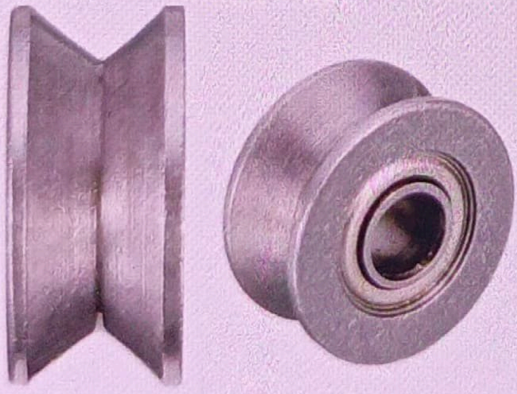
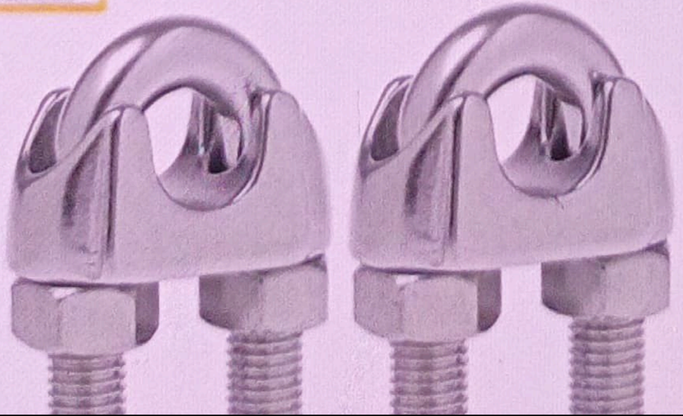


VOLTATEK
ELECTRONICS



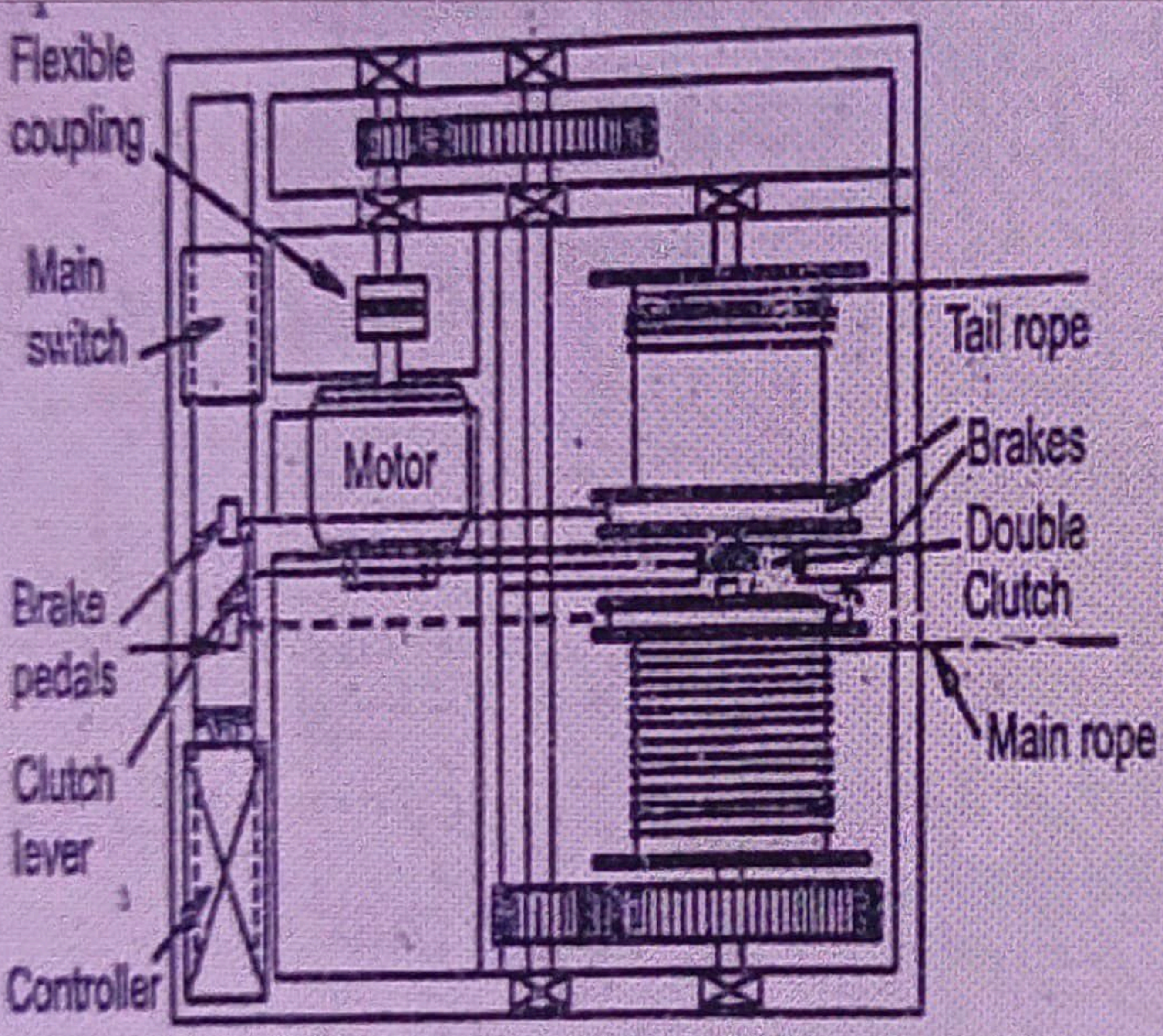

Flexible coupling
Main switch
Brake pedals
Clutch lever
Controller
Motor
Tail rope
Brakes
Double Clutch
Main rope

Fig. 15.10 Main and tail rope haulage

Essentials of haulage

MINING GYAN

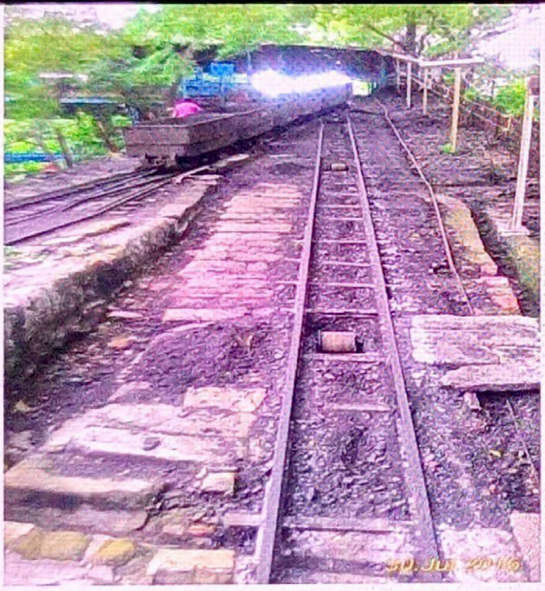
ravity haulage or self acting incline

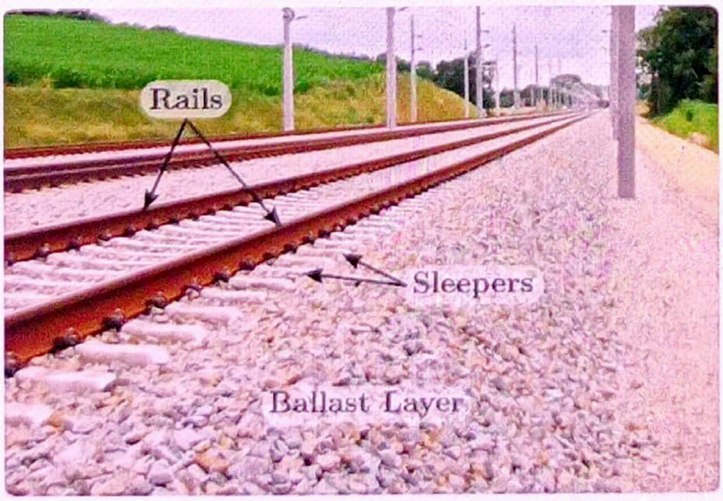
- This is a haulage without any motor or external sources of power and consists of a cast iron pulley, 1.3m – 2m dia, having a brake path on one side and a strap brake
- It is located at the top of an inclined roadway
- It is lowered by gravity loads attached to one end of the rope while simultaneously hoisting empties attached to another end of the rope which passes round the jig pulley
- The jig pulley is vertical
- Only single track is required for its operation but at the mid way of the road where the loads and empties meet, double track or a bye pass is essential

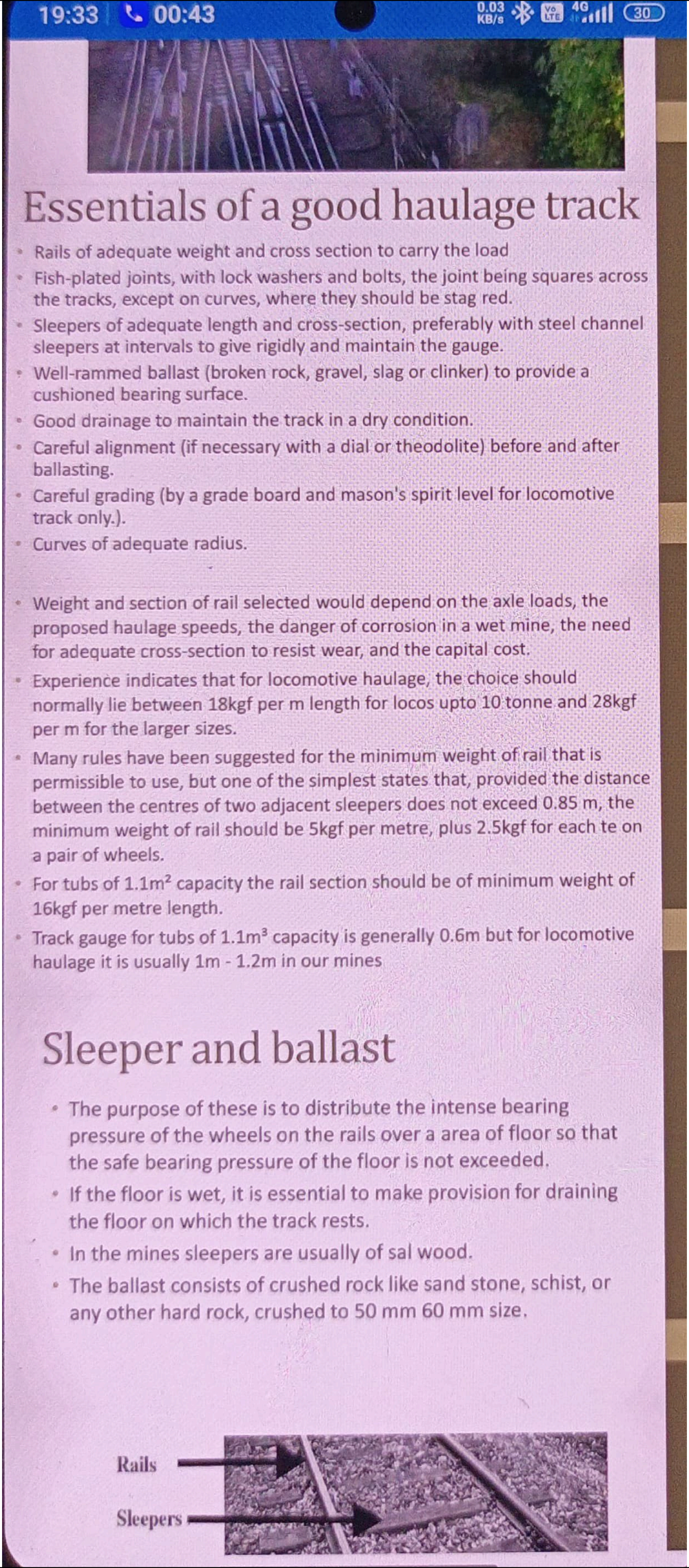
alamy
www.alamy.com

19:32

alamy
www.alamy.com


30. Jun 2016


Rails
Sleepers
Ballast Layer



Essentials of a good haulage track

- Rails of adequate weight and cross section to carry the load
- Fish-plated joints, with lock washers and bolts, the joint being squares across the tracks, except on curves, where they should be stag red.
- Sleepers of adequate length and cross-section, preferably with steel channel sleepers at intervals to give rigidly and maintain the gauge.
- Well-rammed ballast (broken rock, gravel, slag or clinker) to provide a cushioned bearing surface.
- Good drainage to maintain the track in a dry condition.
- Careful alignment (if necessary with a dial or theodolite) before and after ballasting.
- Careful grading (by a grade board and mason's spirit level for locomotive track only.).
- Curves of adequate radius.

- Weight and section of rail selected would depend on the axle loads, the proposed haulage speeds, the danger of corrosion in a wet mine, the need for adequate cross-section to resist wear, and the capital cost.
- Experience indicates that for locomotive haulage, the choice should normally lie between 18kgf per m length for locos upto 10 tonne and 28kgf per m for the larger sizes.
- Many rules have been suggested for the minimum weight of rail that is permissible to use, but one of the simplest states that, provided the distance between the centres of two adjacent sleepers does not exceed 0.85 m, the minimum weight of rail should be 5kgf per metre, plus 2.5kgf for each te on a pair of wheels.
- For tubs of $1.1m^2$ capacity the rail section should be of minimum weight of 16kgf per metre length.
- Track gauge for tubs of $1.1m^3$ capacity is generally 0.6m but for locomotive haulage it is usually 1m - 1.2m in our mines

Sleeper and ballast

- The purpose of these is to distribute the intense bearing pressure of the wheels on the rails over a area of floor so that the safe bearing pressure of the floor is not exceeded.
- If the floor is wet, it is essential to make provision for draining the floor on which the track rests.
- In the mines sleepers are usually of sal wood.
- The ballast consists of crushed rock like sand stone, schist, or any other hard rock, crushed to 50 mm 60 mm size.

a pair of wheels.

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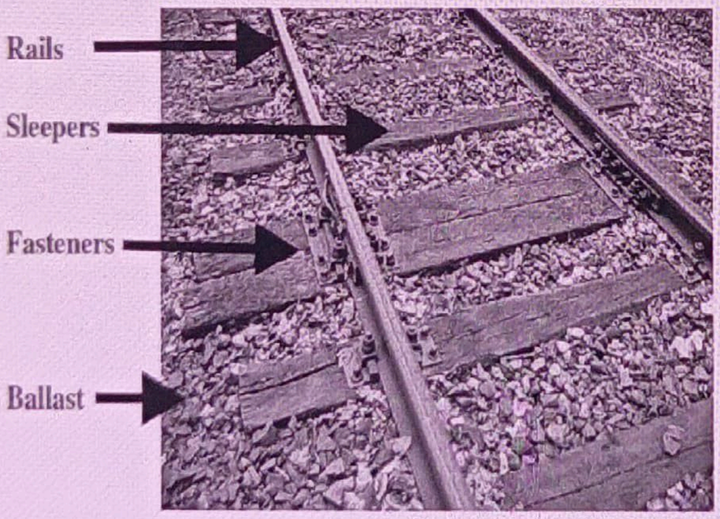

Curves and super elevation

- The minimum radius of curve on which locomotives and mine cars can operate is dependent on a number of factors including length of rigid wheel-base, rail gauge, diameter of wheels, super-elevation and speed.
- Sharp curves cause increased tractive resistance, excessive rail and wheel wear, derailments and possible breakage of locomotive axles.

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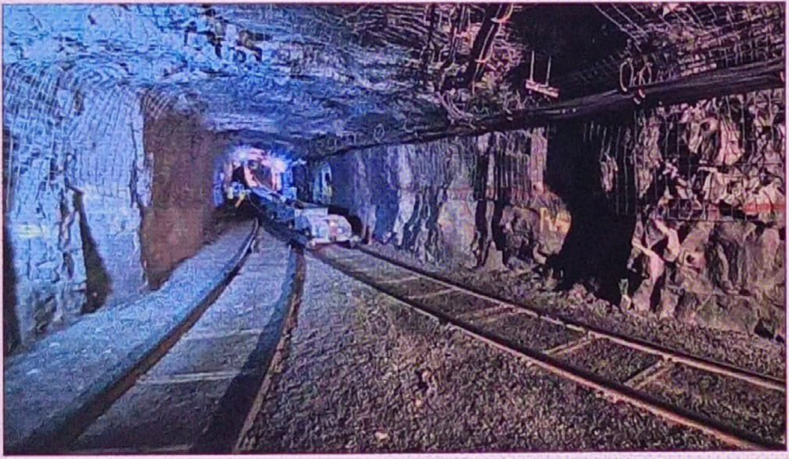
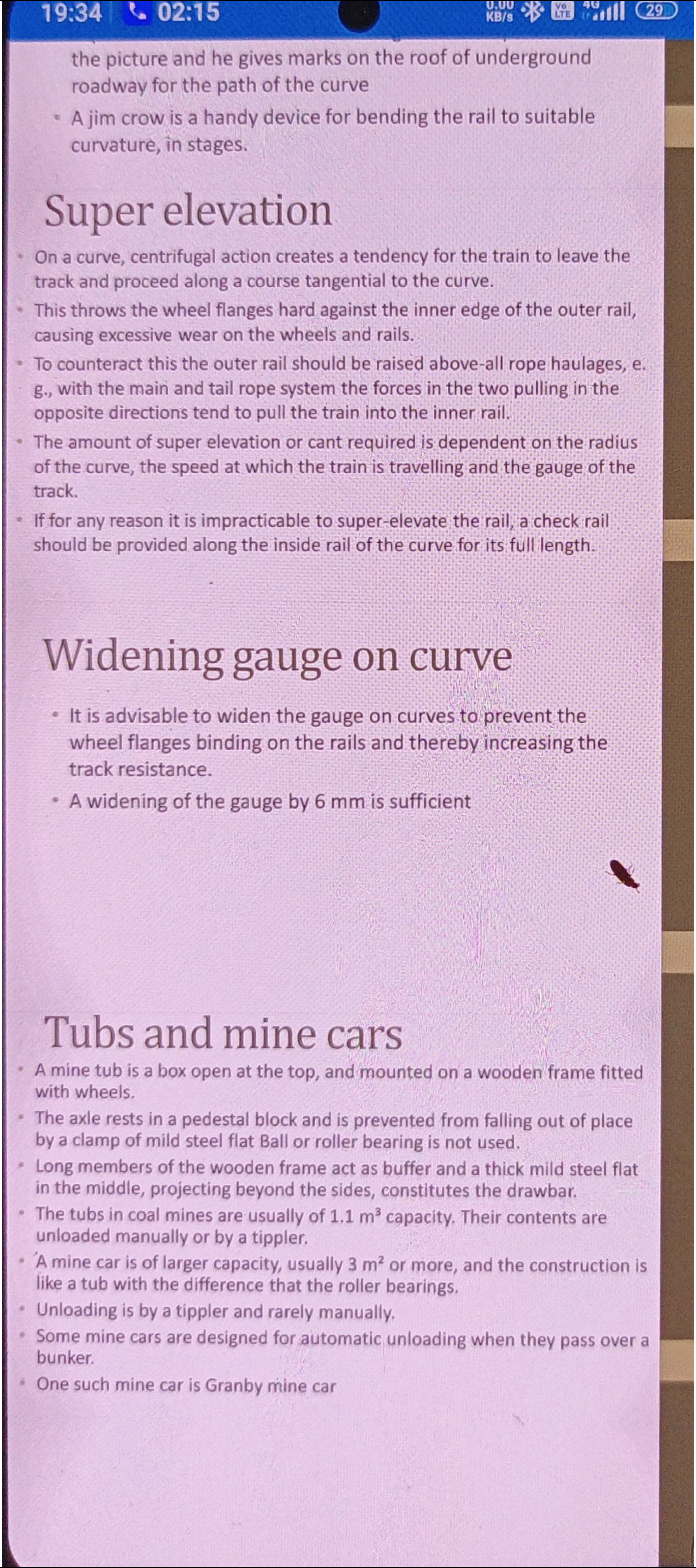


Curve Radius

- It is suggested that for speeds upto 13 km/hr the radius of any curve in a main haulage road should be not less than 20 times the longest rigid wheel-base of any vehicle in the train; and for speed overs 13 km/hr the radius should be greater than this.
- The plate layer or line mistry lays down the curve by experience but for locomotive haulage the surveyor comes in the picture and he gives marks on the roof of underground roadway for the path of the curve
- A jim crow is a handy device for bending the rail to suitable curvature, in stages.

Super elevation

- On a curve, centrifugal action creates a tendency for the train to leave the track and proceed along a course tangential to the curve.
- This throws the wheel flanges hard against the inner edge of the outer rail, causing excessive wear on the wheels and rails.
- To counteract this the outer rail should be raised above-all rope haulages, e. g., with the main and tail rope system the forces in the two pulling in the opposite directions tend to pull the train into the inner rail.
- The amount of super elevation or cant required is dependent on the radius of the curve, the speed at which the train is travelling and the gauge of the



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- The amount of super elevation or cant required is dependent on the radius of the curve, the speed at which the train is travelling and the gauge of the track.
- If for any reason it is impracticable to super-elevate the rail, a check rail should be provided along the inside rail of the curve for its full length.

Widening gauge on curve

- It is advisable to widen the gauge on curves to prevent the wheel flanges binding on the rails and thereby increasing the track resistance.
- A widening of the gauge by 6 mm is sufficient

Tubs and mine cars

- A mine tub is a box open at the top, and mounted on a wooden frame fitted with wheels.
- The axle rests in a pedestal block and is prevented from falling out of place by a clamp of mild steel flat Ball or roller bearing is not used.
- Long members of the wooden frame act as buffer and a thick mild steel flat in the middle, projecting beyond the sides, constitutes the drawbar.
- The tubs in coal mines are usually of 1.1 m^3 capacity. Their contents are unloaded manually or by a tippler.
- A mine car is of larger capacity, usually 3 m^2 or more, and the construction is like a tub with the difference that the roller bearings.
- Unloading is by a tippler and rarely manually.
- Some mine cars are designed for automatic unloading when they pass over a bunker.
- One such mine car is Granby mine car

Essentials of haulage

MINING GYAN

Super elevation

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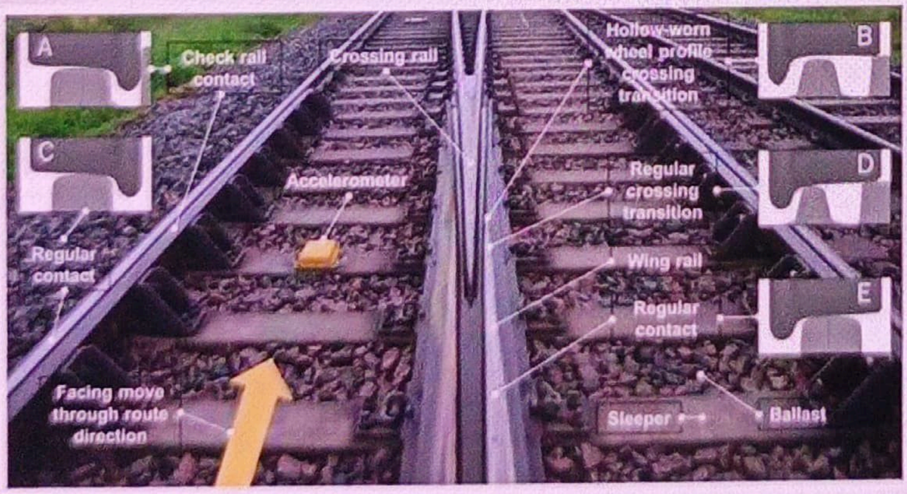
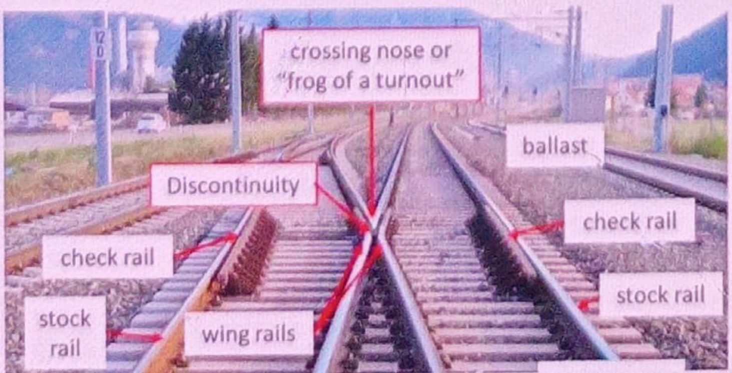
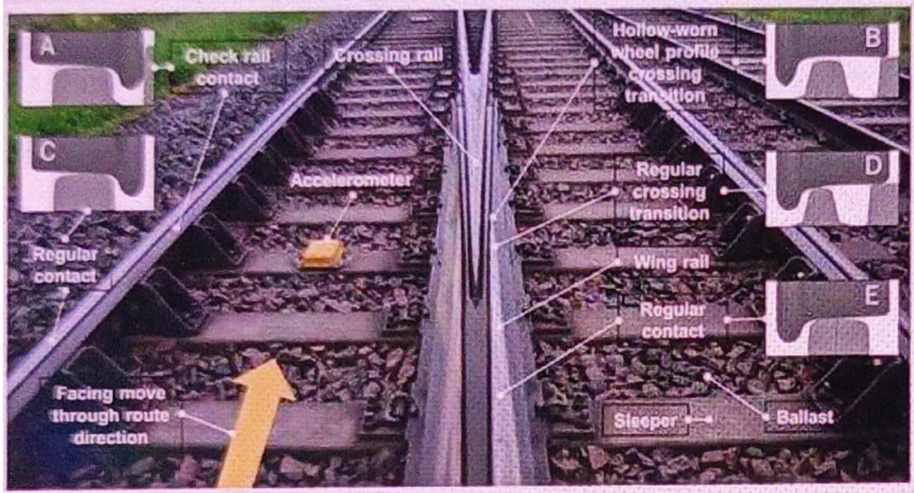
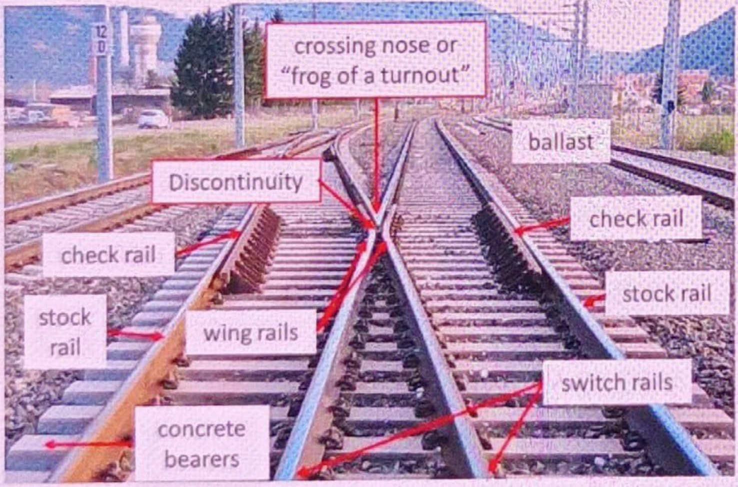

A
Check rail contact
Crossing rail
Hollow-worn wheel profile crossing transition
B
C
Accelerometer
Regular crossing transition
D
Regular contact
Wing rail
Regular contact
E
Facing move through route direction
Sleeper
Ballast


crossing nose or "frog of a turnout"
ballast
Discontinuity
check rail
check rail
stock rail
stock rail
wing rails

of the curve, the speed at which the train is travelling and the gauge of the track.

- If for any reason it is impracticable to super-elevate the rail, a check rail should be provided along the inside rail of the curve for its full length.


A
Check rail contact
Crossing rail
Hollow-worn wheel profile crossing transition
B
C
Accelerometer
Regular crossing transition
D
Regular contact
Wing rail
Regular contact
E
Facing move through route direction
Sleeper
Ballast


crossing nose or "frog of a turnout"
ballast
Discontinuity
check rail
check rail
stock rail
stock rail
wing rails
switch rails
concrete bearers

Widening gauge on curve

- It is advisable to widen the gauge on curves to prevent the wheel flanges binding on the rails and thereby increasing the

Widening gauge on curve

- It is advisable to widen the gauge on curves to prevent the wheel flanges binding on the rails and thereby increasing the track resistance.
- A widening of the gauge by 6 mm is sufficient

Tubs and mine cars

- A mine tub is a box open at the top, and mounted on a wooden frame fitted with wheels.
- The axle rests in a pedestal block and is prevented from falling out of place by a clamp of mild steel flat Ball or roller bearing is not used.
- Long members of the wooden frame act as buffer and a thick mild steel flat in the middle, projecting beyond the sides, constitutes the drawbar.
- The tubs in coal mines are usually of 1.1 m^3 capacity. Their contents are unloaded manually or by a tippler.
- A mine car is of larger capacity, usually 3 m^2 or more, and the construction is like a tub with the difference that the roller bearings.
- Unloading is by a tippler and rarely manually.
- Some mine cars are designed for automatic unloading when they pass over a bunker.
- One such mine car is Granby mine car

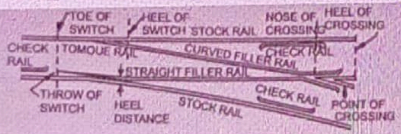

TOE OF SWITCH
HEEL OF SWITCH
STOCK RAIL
NOSE OF CROSSING
HEEL OF CROSSING
CHECK RAIL
TOMOUE RAIL
CURVED FILLER RAIL
CHECK RAIL
STRAIGHT FILLER RAIL
THROW OF SWITCH
HEEL DISTANCE
STOCK RAIL
CHECK RAIL
POINT OF CROSSING

Fig. 15.14 Layout of points and crossings

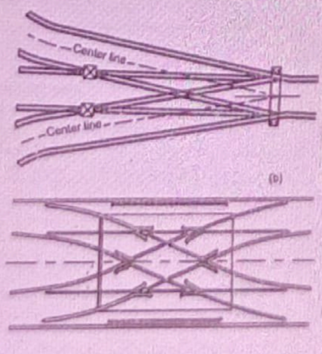

Center line
Center line
(b)

Fig. 15.15 (a) 3-way finger switch. (b) diamond crossing

Safety devices on haulage roads

- Monkey or back catch
    - A pivoted piece of steel rail placed between the track rails so as to catch the axle of a backward runaway
    - A wooden block pivoted at one end and pressed over the rail by a strong spring
    - It is used for endless haulage track for tubs moving up gradient
- Stop block
    - This consist of a wooden beam or block lying across the rails, pivoted at one end and held against pivoted side block at the other

Safety devices on haulage roads

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  - It is used for endless haulage track for tubs moving up gradient
- Stop block
  - This consist of a wooden beam or block lying across the rails, pivoted at one end and held against pivoted side block at the other
  - It is a good plan to have two stop blocks some distance apart the one forming a reserve for the other

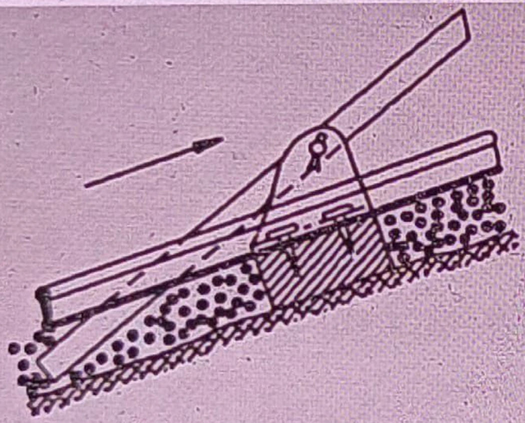


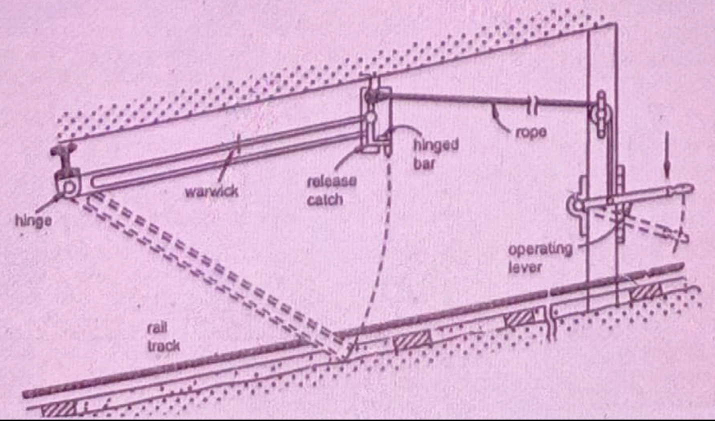
Fig. 15.18 A bac

Backstay

- This is used behind an ascending set of tubs on a direct haulage road or on an endless haulage
- It is attached to the tub axle and in the event of runaway of tubs, the pointed end of the backstay stops against sleeper of the track and travel of the tub or train of tubs is arrested

Drop warwick

- This is intended for arresting forward runaways, being placed below the brow of an incline and also near the bottom and below intermediate levels
- It consists of a heavy bulk or girder hinged at one end to a specifically set roof girder and held up at the other by an eye bolt and pin
- The warwick is released when required in emergency by a haulage worker pulling the warwick is released when required in emergency by a haulage worker pulling the wire to withdraw the pin



- It consists of a heavy bulk or girder hinged at one end to a specifically set roof girder and held up at the other by an eye bolt and pin
- The warwick is released when required in emergency by a haulage worker pulling the warwick is released when required in emergency by a haulage worker pulling the wire to withdraw the pin

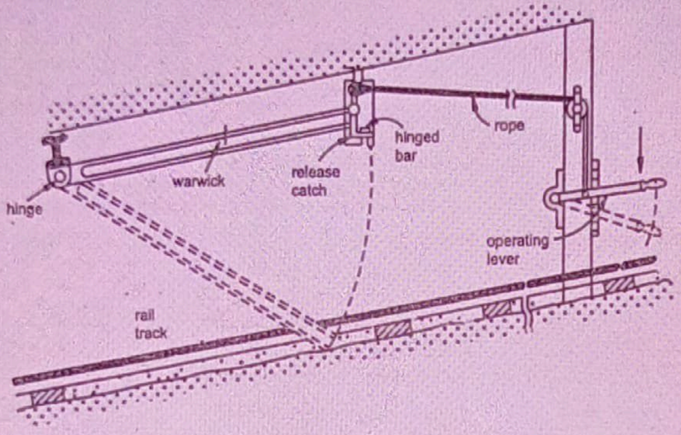


Fig. 15.19. Drop warwick.

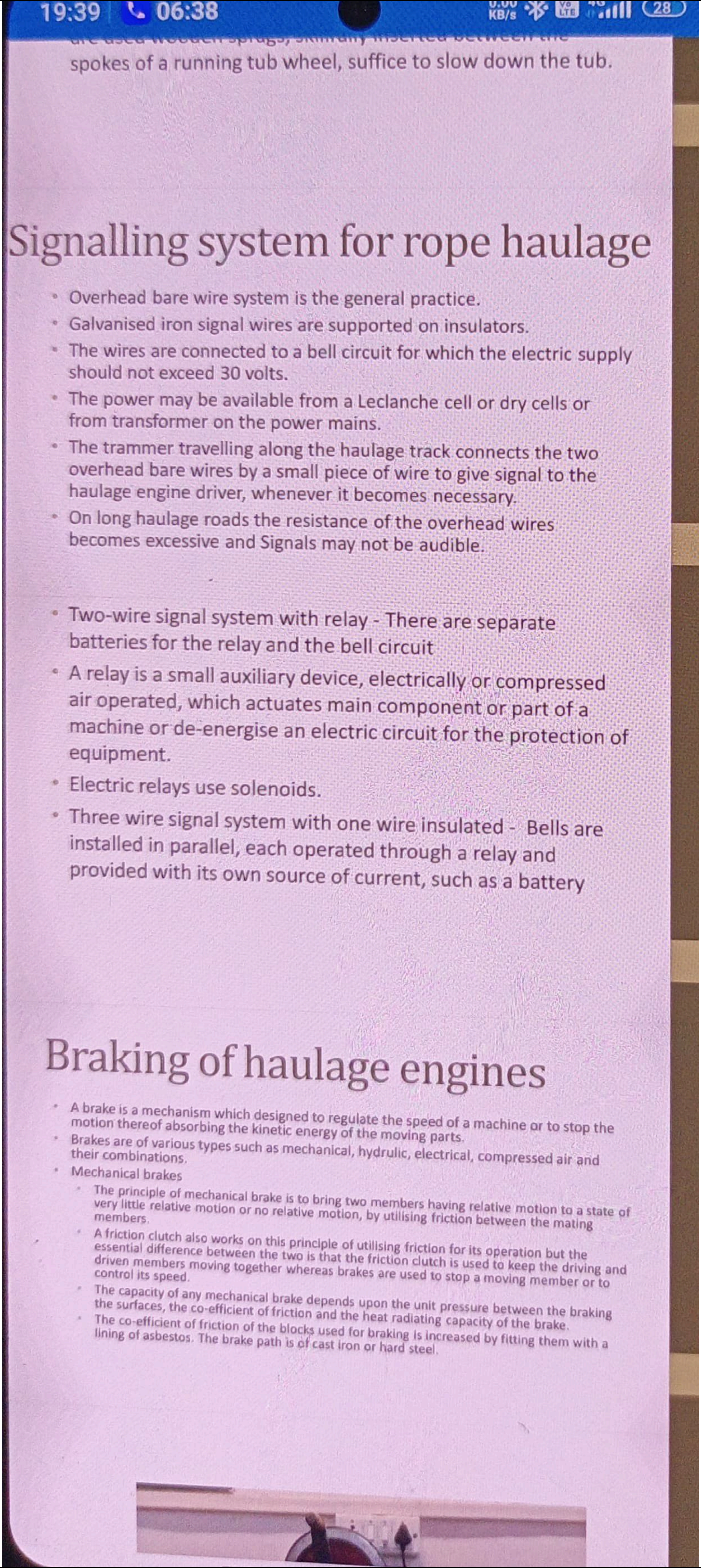
- A combined stopblock and runaway switch
    - This is used at the brow of a direct haulage plane and is so constructed that at one time either the stopblock or the runaway switch in the event of a runaway of a set of tubs
    - It is manually operated by the haulage attendant when the set of tubs has to pass clear of the stopblock

Hydraulic tub retarder

- It consists of a hydraulic cylinder containing opposed pistons.
- The hydraulic pressure is supplied from a 1-2 kW electric motor driven pump.
- The hydraulic tub retarders are used for locomotive haulages but for ordinary rope haulage where tubs of 1.1 m^3 capacity are used wooden sprags, skillfully inserted between the spokes of a running tub wheel, suffice to slow down the tub.

Signalling system for rope haulage

- Overhead bare wire system is the general practice.
- Galvanised iron signal wires are supported on insulators.



spokes of a running tub wheel, suffice to slow down the tub.

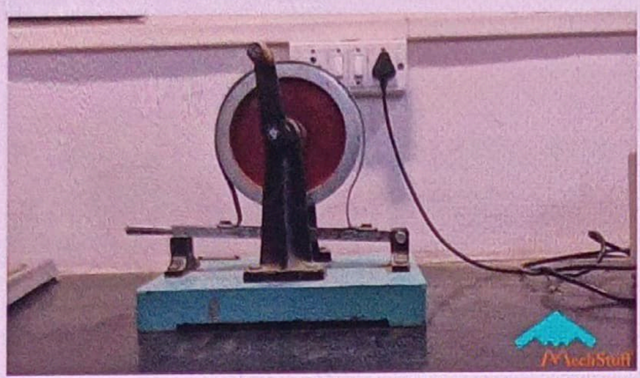
Signalling system for rope haulage

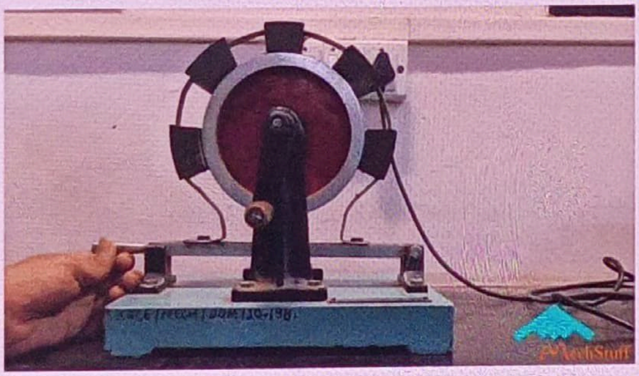
- Overhead bare wire system is the general practice.
- Galvanised iron signal wires are supported on insulators.
- The wires are connected to a bell circuit for which the electric supply should not exceed 30 volts.
- The power may be available from a Leclanche cell or dry cells or from transformer on the power mains.
- The trammer travelling along the haulage track connects the two overhead bare wires by a small piece of wire to give signal to the haulage engine driver, whenever it becomes necessary.
- On long haulage roads the resistance of the overhead wires becomes excessive and Signals may not be audible.

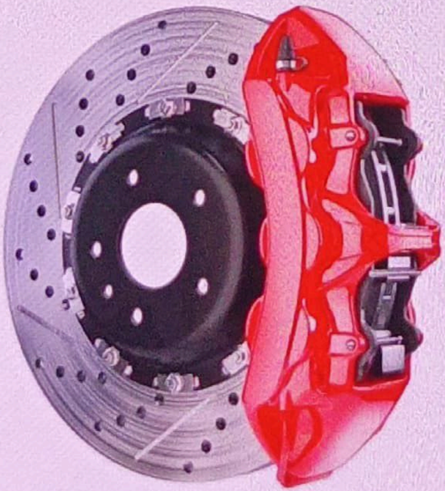
- Two-wire signal system with relay - There are separate batteries for the relay and the bell circuit
- A relay is a small auxiliary device, electrically or compressed air operated, which actuates main component or part of a machine or de-energise an electric circuit for the protection of equipment.
- Electric relays use solenoids.
- Three wire signal system with one wire insulated - Bells are installed in parallel, each operated through a relay and provided with its own source of current, such as a battery

Braking of haulage engines

- A brake is a mechanism which designed to regulate the speed of a machine or to stop the motion thereof absorbing the kinetic energy of the moving parts.
- Brakes are of various types such as mechanical, hydrulic, electrical, compressed air and their combinations.
- Mechanical brakes
  - The principle of mechanical brake is to bring two members having relative motion to a state of very little relative motion or no relative motion, by utilising friction between the mating members.
  - A friction clutch also works on this principle of utilising friction for its operation but the essential difference between the two is that the friction clutch is used to keep the driving and driven members moving together whereas brakes are used to stop a moving member or to control its speed.
  - The capacity of any mechanical brake depends upon the unit pressure between the braking surfaces, the co-efficient of friction and the heat radiating capacity of the brake.
  - The co-efficient of friction of the blocks used for braking is increased by fitting them with a lining of asbestos. The brake path is of cast iron or hard steel.





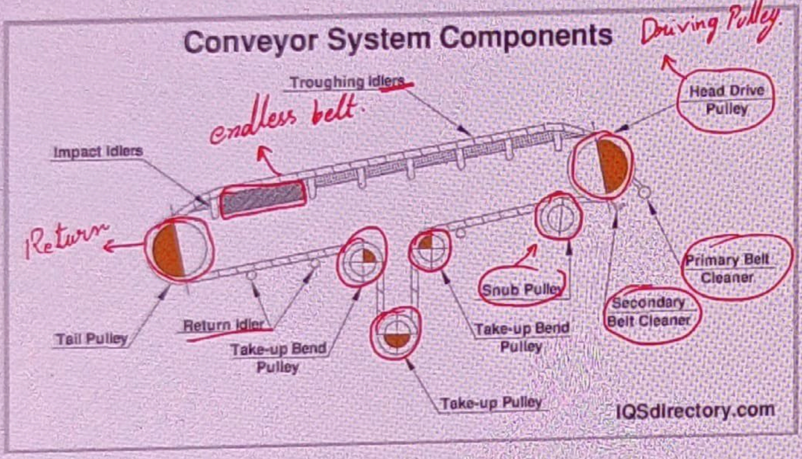


- The types of brakes commonly used for mining machinery are:-
  - Block brakes
    - Post type brakes
    - Caliper type brakes
  - Band brakes or strap brakes
  - Disc brakes

MINING GYAN

Conveyor belt

By – Devendra Singh Tomar


Conveyor System Components
Driving Pulley.
Troughing idlers
endless belt.
Head Drive Pulley
Impact Idlers
Return
Snub Pulley
Primary Belt Cleaner
Secondary Belt Cleaner
Tail Pulley
Return idler
Take-up Bend Pulley
Take-up Bend Pulley
Take-up Pulley
IQSdirectory.com

→ which type of belt is used in conveyor belt system?
Ans → endless belt.

→ In which type of pulley motor is attached in Conveyor belt system?
Ans → Driving Pulley & Head Pulley.

Belt Conveyor consists of :-

① flat endless belt → continuously travel
→ material को transport करना

② Idler → belt को support देना

③ Channel/angle iron → Idler इसके ऊपर mounted होता है।

④ Loop take up arrangement → Conveyor belt में tension provide कराना

⑤ Drums → at discharge end
→ at loading end → Conveyor belt इसके

Belt Conveyor consists of :-

① Flat endless belt → continuously travel
→ material को transport करना

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③ Channel/angle iron → Idler इसके ऊपर mounted होता है।

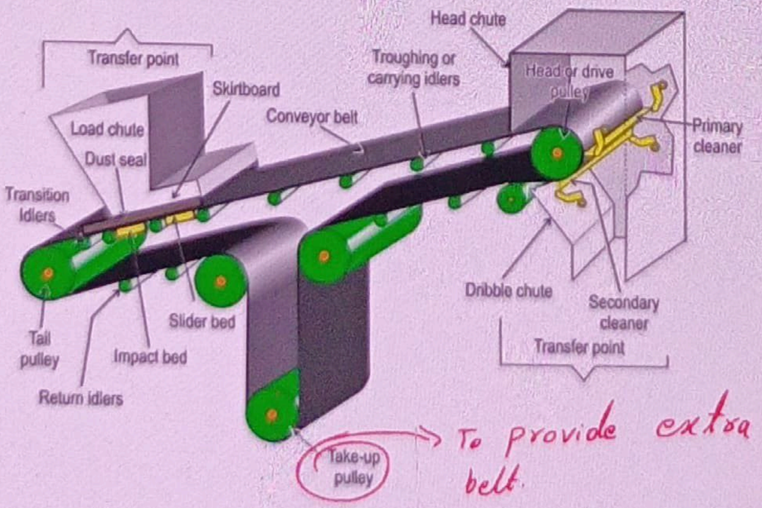
④ Loop take up arrangement → Conveyor belt में tension provide कराना

⑤ Drums → at discharge end
→ at loading end → Conveyor belt इसके ऊपर rotate होता है।

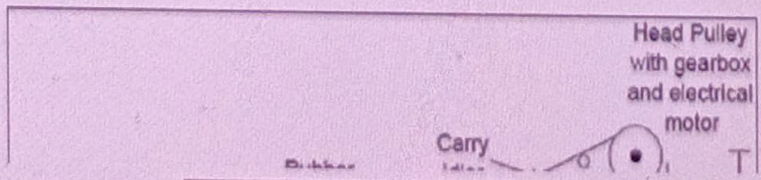
⑥ Driving head → electric motor
→ Coupling
↳ gearing
↓
Snub pulley → Increases angle of contact.

⑦ Take Up Bend pulley → Take up pulley में angle of contact बढ़ाना
→ To increase tensioning.

⑧ Impact Idler → Ore chute
→ Loading Point
↳ feeding Point.
} इन सभी locations पर impact idler लगा होता है।
↑ Load chute

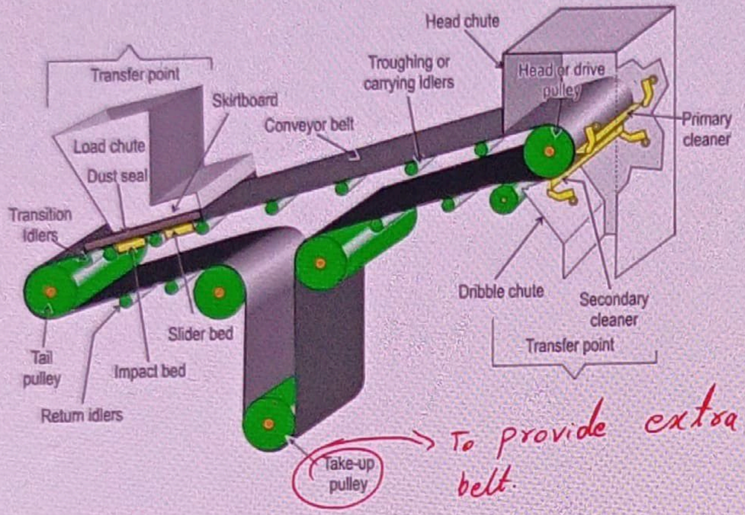

Head chute
Transfer point
Troughing or carrying idlers
Skirtboard
Head or drive pulley
Conveyor belt
Load chute
Primary cleaner
Dust seal
Transition idlers
Dribble chute
Secondary cleaner
Slider bed
Transfer point
Tail pulley
Impact bed
Return idlers
Take-up pulley

→ To provide extra belt.

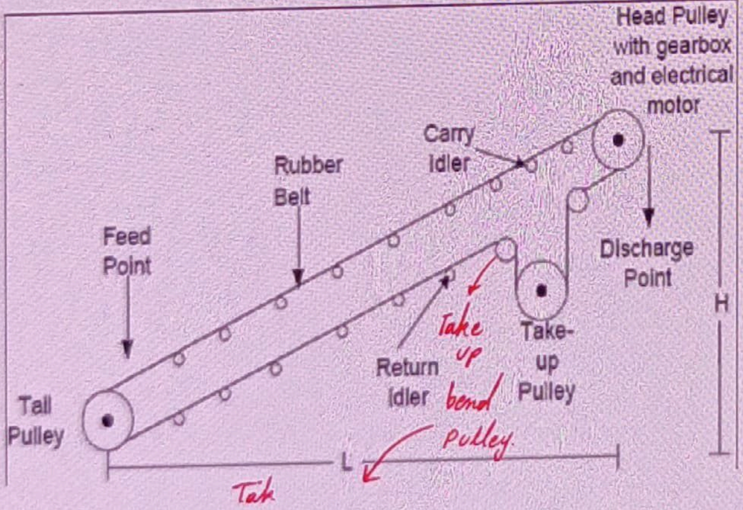

Head Pulley with gearbox and electrical motor
Carry
T

"To increase tensioning

⑧ Impact Idler → Ore chute } इन सभी locations
↓ ↳ Loading Point } पर impact idler
load chute ↳ feeding Point. } लगा होता है।

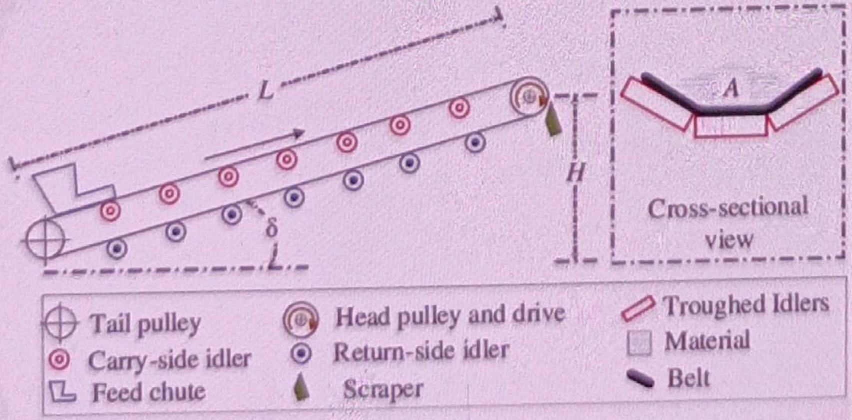

Transfer point
Skirtboard
Conveyor belt
Troughing or carrying idlers
Head chute
Head or drive pulley
Primary cleaner
Load chute
Dust seal
Transition idlers
Tail pulley
Return idlers
Impact bed
Slider bed
Dribble chute
Secondary cleaner
Transfer point
Take-up pulley

→ To provide extra belt.


Head Pulley with gearbox and electrical motor
Carry Idler
Rubber Belt
Feed Point
Discharge Point
H
Tail Pulley
Return Idler
Take-up Pulley
L

Take up bend pulley

Tak


L
H
δ
A
Cross-sectional view
Tail pulley
Carry-side idler
Feed chute
Head pulley and drive
Return-side idler
Scraper
Troughed Idlers
Material
Belt

→ Snub Pulley → ① Driving pulley में angle of contact increase करता है।

② Belt के pull force (खींचने वाला force)

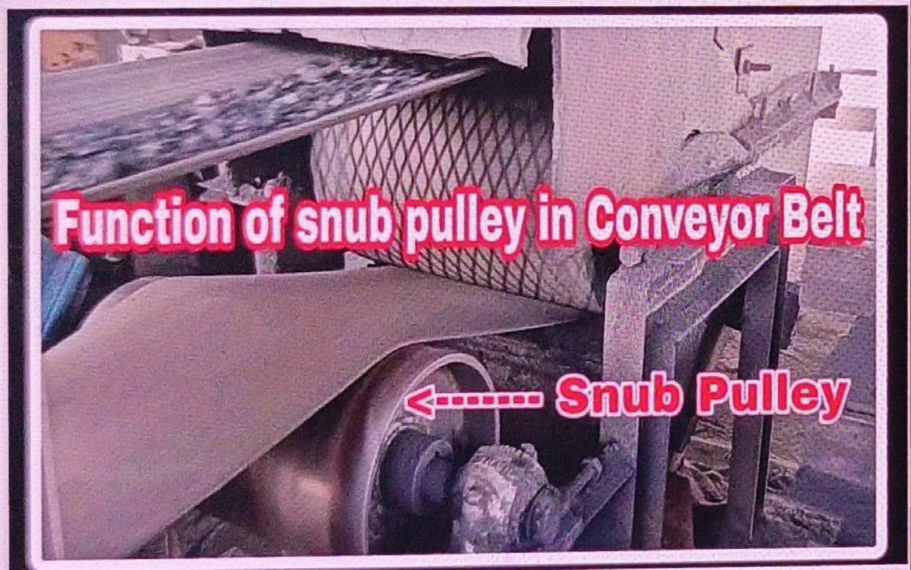
को कम करता

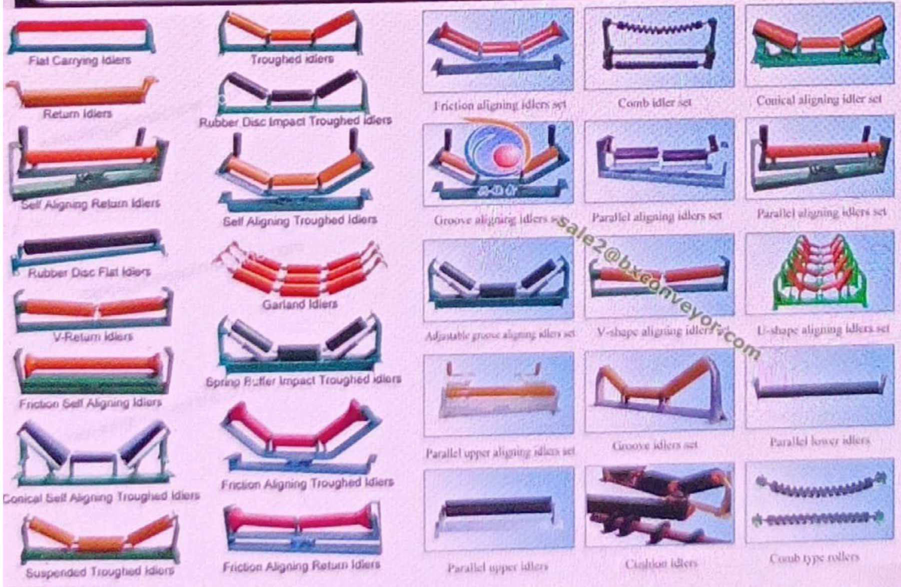
→ Snub Pulley → ① Driving pulley में angle of contact increase करता है।

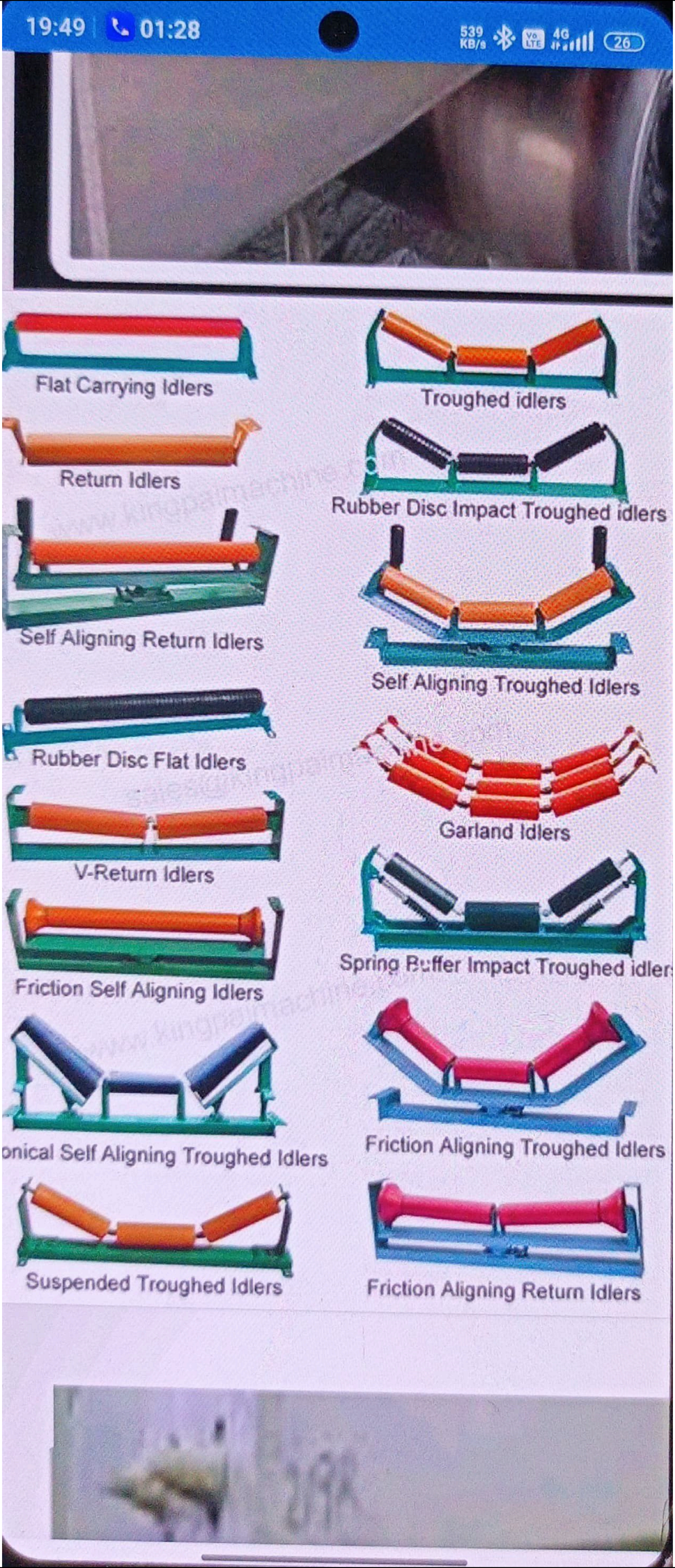
② Belt के pull force (खींचने वाला force) को कम करता

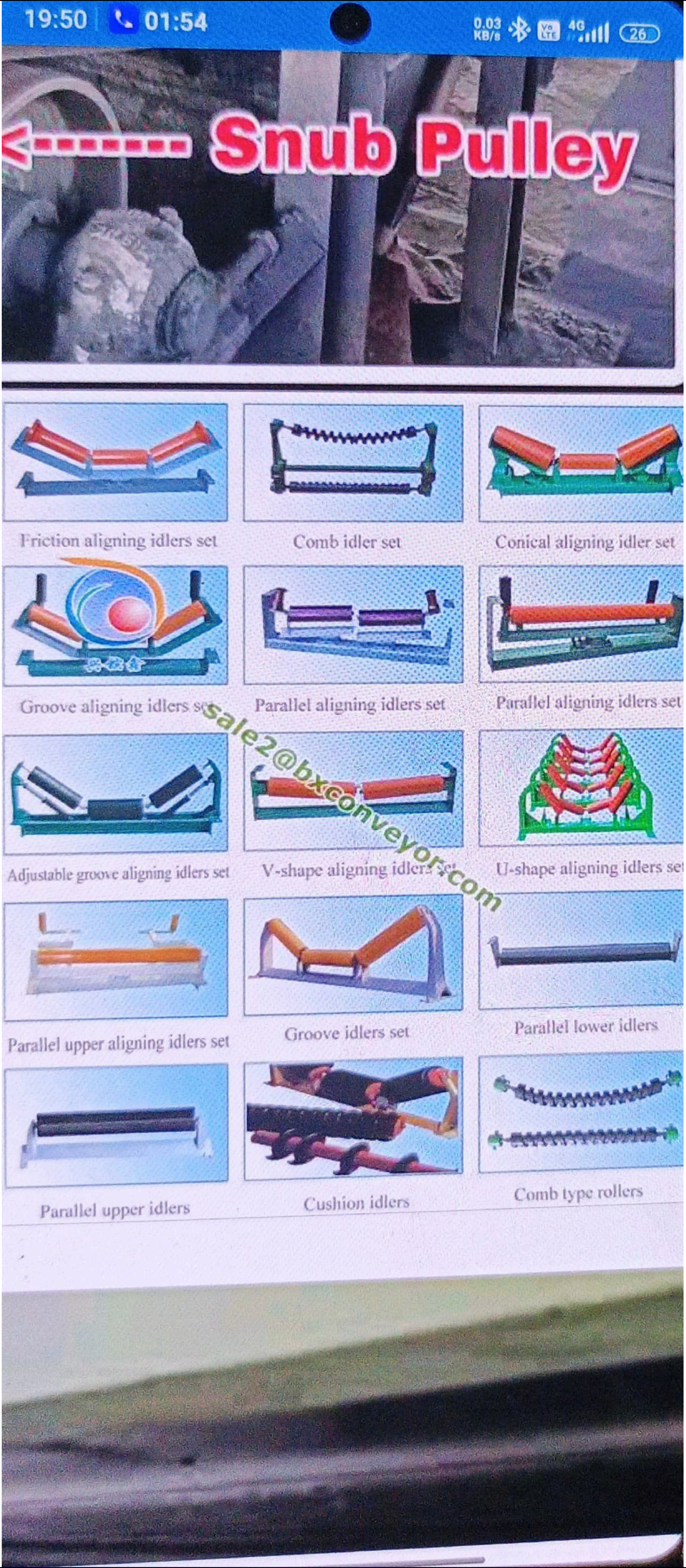
③ belt के Tension (खींचाव) को कम करता है।

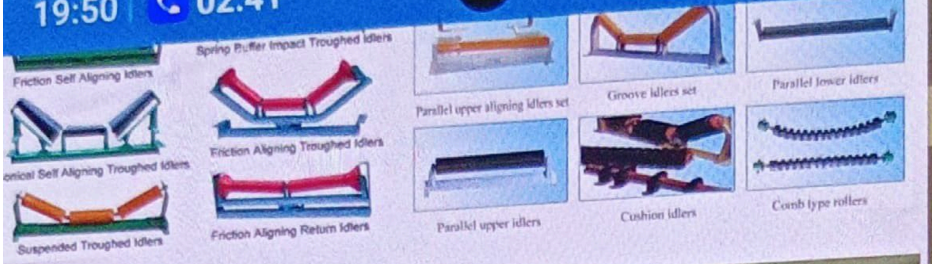
④ कम stregth वाले belt भी use कर सकते है।

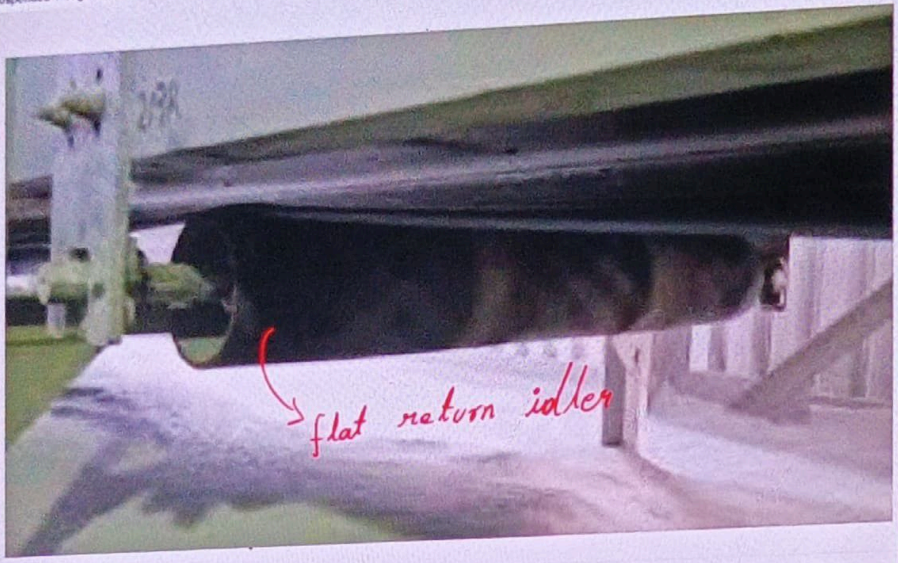

Function of snub pulley in Conveyor Belt
Snub Pulley


Flat Carrying Idlers
Troughed Idlers
Return Idlers
Rubber Disc Impact Troughed Idlers
Self Aligning Return Idlers
Self Aligning Troughed Idlers
Rubber Disc Flat Idlers
Garland Idlers
V-Return Idlers
Spring Buffer Impact Troughed Idlers
Friction Self Aligning Idlers
Conical Self Aligning Troughed Idlers
Friction Aligning Troughed Idlers
Suspended Troughed Idlers
Friction Aligning Return Idlers
Friction aligning idlers set
Comb idler set
Conical aligning idler set
Groove aligning idlers set
Parallel aligning idlers set
Parallel aligning idlers set
Adjustable groove aligning idlers set
V-shape aligning idlers set
U-shape aligning idlers set
Parallel upper aligning idlers set
Groove idlers set
Parallel lower idlers
Parallel upper idlers
Cushion idlers
Comb type rollers
sale2@bxconveyor.com

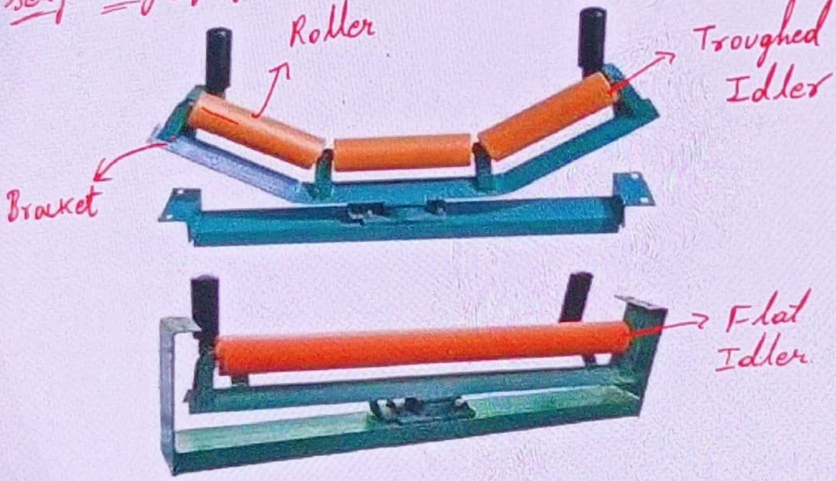

19:49
01:28
539 KB/s
4G
26
Flat Carrying Idlers
Troughed idlers
Return Idlers
Rubber Disc Impact Troughed idlers
Self Aligning Return Idlers
Self Aligning Troughed Idlers
Rubber Disc Flat Idlers
Garland Idlers
V-Return Idlers
Spring Buffer Impact Troughed idler
Friction Self Aligning Idlers
Friction Aligning Troughed Idlers
onical Self Aligning Troughed Idlers
Suspended Troughed Idlers
Friction Aligning Return Idlers
www.kingpaimachine.com


19:50
01:54
Snub Pulley
Friction aligning idlers set
Comb idler set
Conical aligning idler set
Groove aligning idlers set
Parallel aligning idlers set
Parallel aligning idlers set
Adjustable groove aligning idlers set
V-shape aligning idlers set
U-shape aligning idlers set
Parallel upper aligning idlers set
Groove idlers set
Parallel lower idlers
Parallel upper idlers
Cushion idlers
Comb type rollers
sale2@bxconveyor.com


Friction Self Aligning Idlers
Spring Buffer Impact Troughed Idlers
Parallel upper aligning idlers set
Groove idlers set
Parallel lower idlers
onical Self Aligning Troughed Idlers
Friction Aligning Troughed Idlers
Suspended Troughed Idlers
Friction Aligning Return Idlers
Parallel upper idlers
Cushion idlers
Comb type rollers

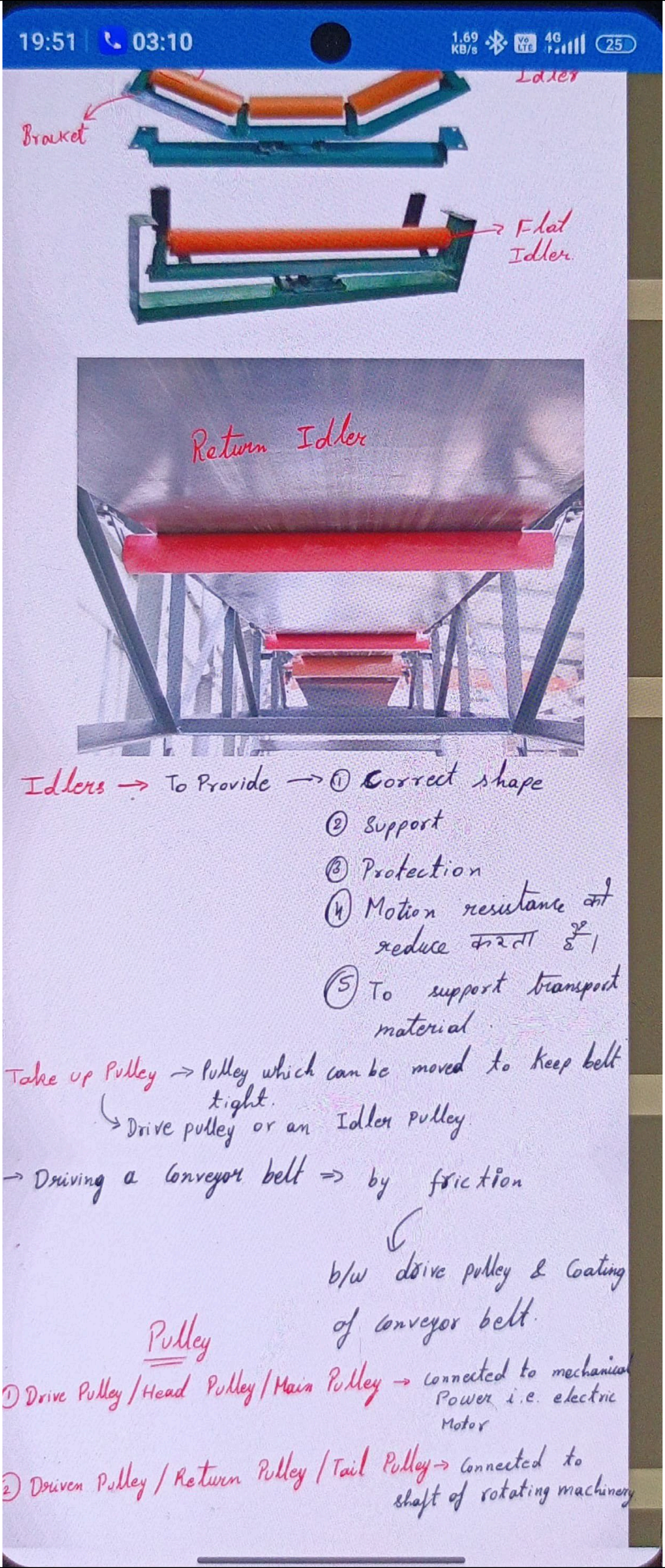

flat return idler

Self Aligning Idlers.


Roller
Troughed Idler
Bracket
Flat Idler.

Return Idler

Idlers → To Provide → ① Correct shape
② Support
③ Protection


19:51
03:10
1.69 KB/s
4G
25
Idler
Braket
Flat Idler
Return Idler

Idlers → To Provide → ① Correct shape
② Support
③ Protection
④ Motion resistance को reduce करती है।
⑤ To support transport material

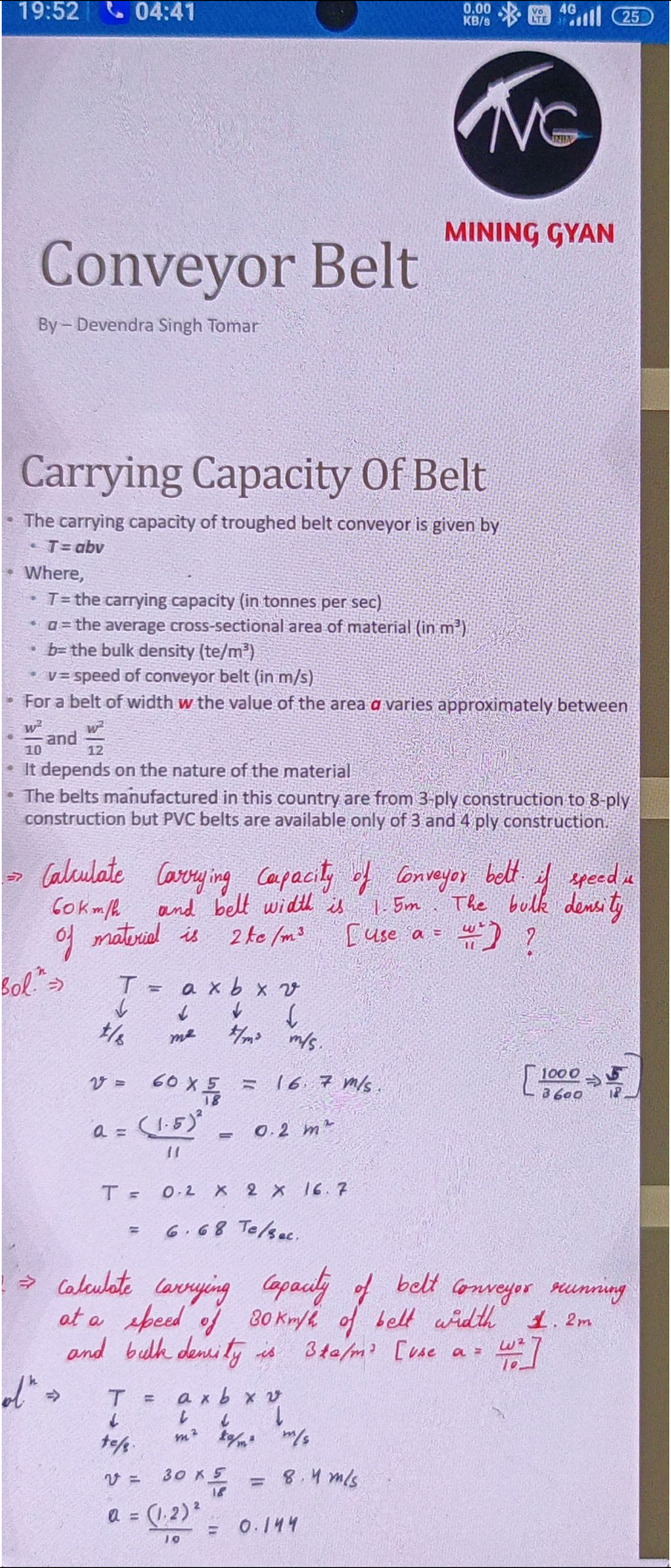
Take up Pulley → Pulley which can be moved to keep belt tight.
↳ Drive pulley or an Idler pulley

→ Driving a conveyor belt ⇒ by friction
↓
b/w drive pulley & Coating of conveyor belt.

Pulley

① Drive Pulley / Head Pulley / Main Pulley → connected to mechanical Power i.e. electric Motor

② Driven Pulley / Return Pulley / Tail Pulley → Connected to shaft of rotating machinery



Conveyor Belt

By – Devendra Singh Tomar

Carrying Capacity Of Belt

- The carrying capacity of troughed belt conveyor is given by
  - *T = abv*
- Where,
  - *T* = the carrying capacity (in tonnes per sec)
  - *a* = the average cross-sectional area of material (in m^3)
  - *b* = the bulk density (te/m^3)
  - *v* = speed of conveyor belt (in m/s)
- For a belt of width **w** the value of the area ***a*** varies approximately between
- $\frac{w^2}{10}$ and $\frac{w^2}{12}$
- It depends on the nature of the material
- The belts manufactured in this country are from 3-ply construction to 8-ply construction but PVC belts are available only of 3 and 4 ply construction.

⇒ Calculate Carrying Capacity of Conveyor belt if speed i 60 Km/h and belt width is 1.5m. The bulk density of material is 2 te/m^3 [use $a = \frac{w^2}{11}$] ?

Sol.ⁿ ⇒

$$\begin{array}{ccccccc} T & = & a & \times & b & \times & v \\ \downarrow & & \downarrow & & \downarrow & & \downarrow \\ t/s & & m^2 & & t/m^3 & & m/s. \end{array}$$

$$v = 60 \times \frac{5}{18} = 16.7 \text{ m/s.} \qquad \left[\frac{1000}{3600} \Rightarrow \frac{5}{18}\right]$$

$$a = \frac{(1.5)^2}{11} = 0.2 \text{ m}^2$$

$$T = 0.2 \times 2 \times 16.7$$
$$= 6.68 \text{ Te/sec.}$$

⇒ Calculate carrying capacity of belt conveyor running at a speed of 30 Km/h of belt width 1.2m and bulk density is 3 te/m^3 [use $a = \frac{w^2}{10}$]

olʰ ⇒

$$\begin{array}{ccccccc} T & = & a & \times & b & \times & v \\ \downarrow & & \downarrow & & \downarrow & & \downarrow \\ te/s. & & m^2 & & te/m^3 & & m/s \end{array}$$

$$v = 30 \times \frac{5}{18} = 8.4 \text{ m/s}$$

$$a = \frac{(1.2)^2}{10} = 0.144$$

Q ⇒ Calculate carrying capacity of belt conveyor running at a speed of 30 Km/h of belt width 1.2m and bulk density is 3 te/m³ [use $a = \frac{w^2}{10}$]

Solⁿ ⇒

$$\underset{te/s}{T} = \underset{m^2}{a} \times \underset{te/m^3}{b} \times \underset{m/s}{v}$$

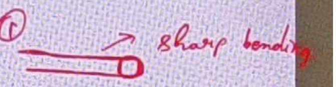
$$v = 30 \times \frac{5}{18} = 8.4\ m/s$$

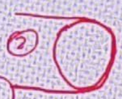
$$a = \frac{(1.2)^2}{10} = 0.144$$

$$T = 0.144 \times 3 \times 8.4$$

$$= 3.6\ Te/s.$$

Care of belt



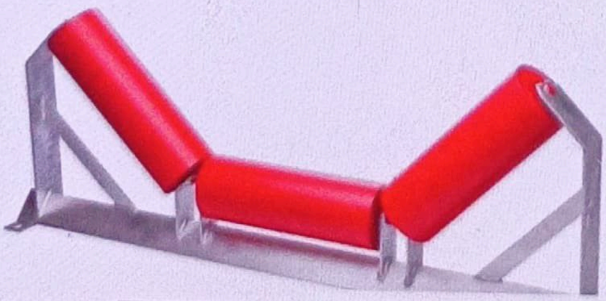


- Protect conveyor belt from direct sunlight
- Keep it away from steam pipes or other places of heat
- Use drive and tail end drums of adequate size to avoid sharp bending of belt
- Avoid too many bending and warpings in belt
- Prevent rubbing of belt → stationary.
- In a troughed belt inclination of side rollers shall not be more than 30°
- Shortening of belt and remaking of joints shall be done in case of cotton fabric belt when it gets affected by moisture.
- Method of feeding influences the belt life

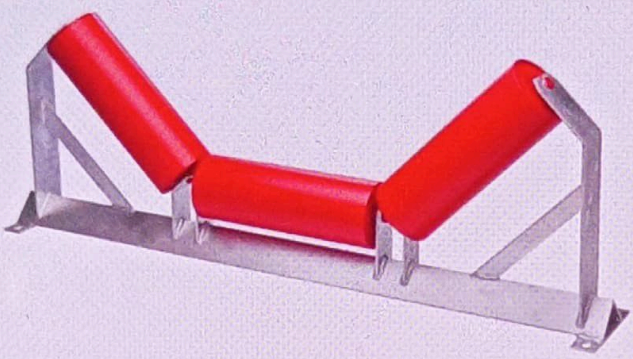
Capillary action

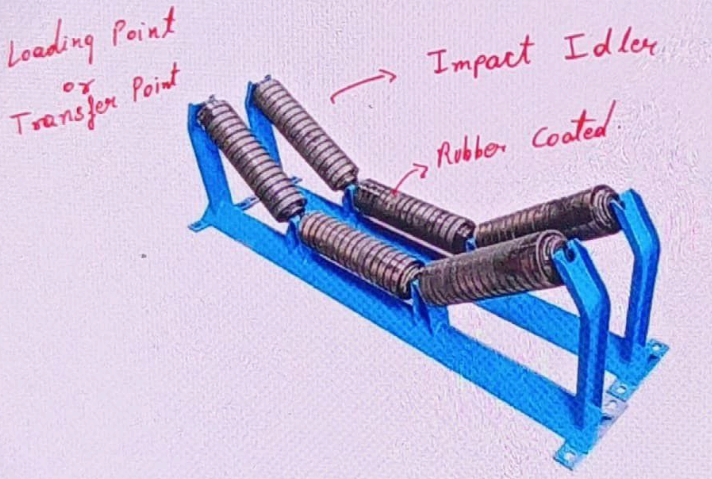
Idlers & supporting structures

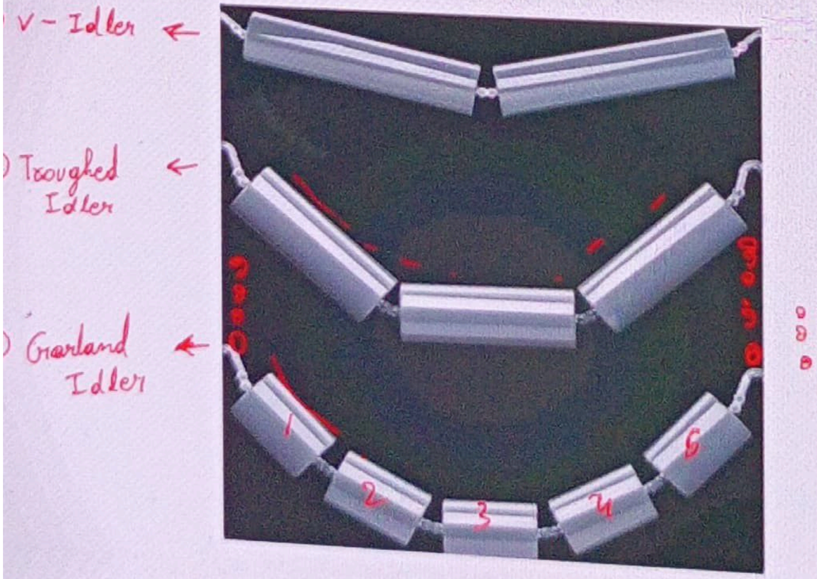
- Idlers are placed at intervals of 1.5m to 2m
- Idlers consist of:-
  - It is a long pulley
  - Moves on its own axle
  - Moves on ball bearing
  - It is filled with grease
- Trough shaped belt shall be used for transport of broken or loose material
- Troughing is achieved by a set of 3 idlers at one place
- Inclination of idlers shall be between 20° to 30°
- Inclination of cotton carcass belts shall not be more than 30°



- Trough shaped belt shall be used for transport of broken or loose material
- Troughing is achieved by a set of 3 idlers at one place
- Inclination of idlers shall be between 20° to 30°
- Inclination of cotton carcass belts shall not be more than 30°

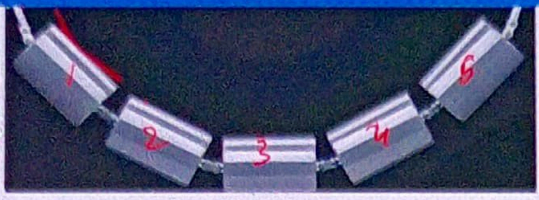



Loading Point or Transfer Point
Impact Idler
Rubber Coated

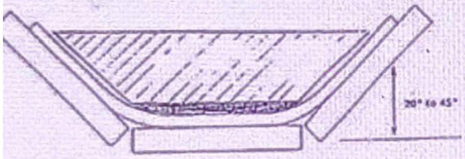

V - Idler
Troughed Idler
Garland Idler
1
2
3
4
5

- **Angle of Surcharge**
  - It is the angle of the material with the horizontal when material is bumped or moving
  - Such as moving belt conveyor

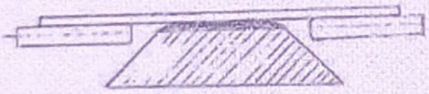
Garland Idler



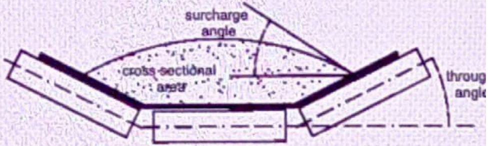
- **Angle of Surcharge**
  - It is the angle of the material with the horizontal when material is bumped or moving
  - Such as moving belt conveyor
  - It is a direct measure of kinetic friction
  - The higher the surcharge angle, the more materials can be stacked on the belt
- **Angle of repose**
  - It is the angle of material with the horizontal when dumped in a pile
  - Such as stock pile or a stationary belt
  - It is a direct measure of the static friction of the material



Belt Troughing
Cleated Trough

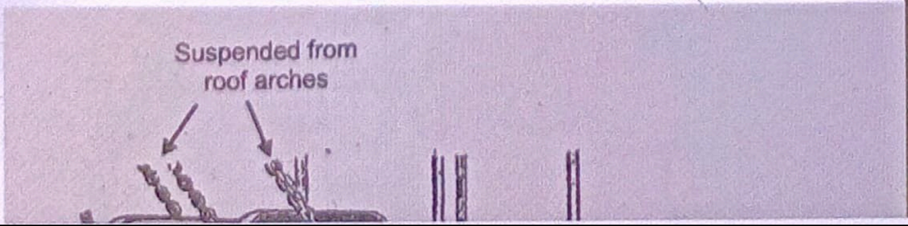


Cleated Trough
Return Side



The Engineering ToolBox
engineeringtoolbox.com

- In wide idlers a set of five separate idlers is used to keep the curve of trough regular
- Idlers are filled with grease for lifetime
- Greasing is not required while installation and over the life
- Some idlers have to be greased once in every 24 hours
- Grease nipples are used to grease the idlers
- Thick rubber layered idlers are used at the transfer point where the idlers have to bear the impact of falling material
- Idlers are supported on channel framework of 3 to 4m length and joined by bolts and nuts
- In UG mines framework rests on floor
- At some points and at discharge end it is suspended from roof by eye bolts and chains



- At some points and at discharge end it is suspended from roof by eye bolts and chains

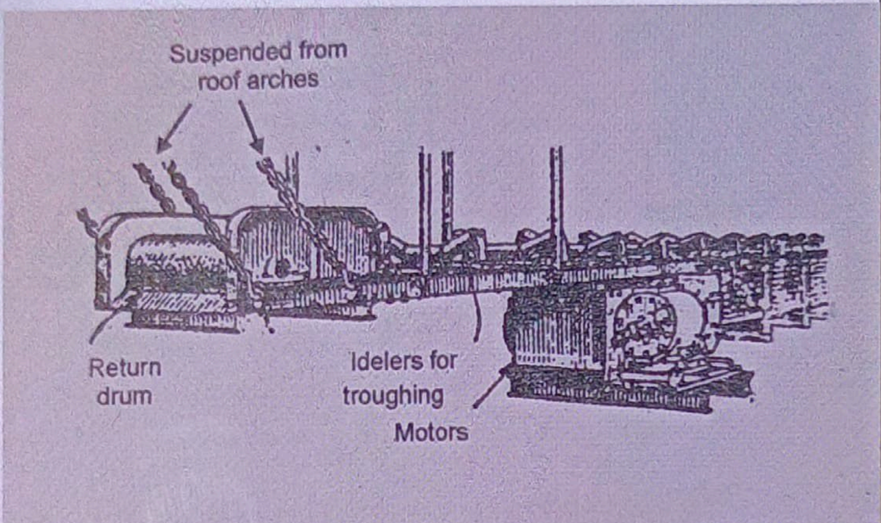

Suspended from roof arches
Return drum
Idelers for troughing
Motors

Fig. 17.5 Framework of belt conveyor supported from roof.

- The direction of axles of the idlers, and the delivery end drum and the tail end drum should be at right angles to the direction of belt travel. If it is not done it results in:-
  - belt conveyor wanders away from the centre line for part of its length
  - It troughing gets disturbed resulting spillage of the contents
  - Rubbing of belt edge against stationary parts

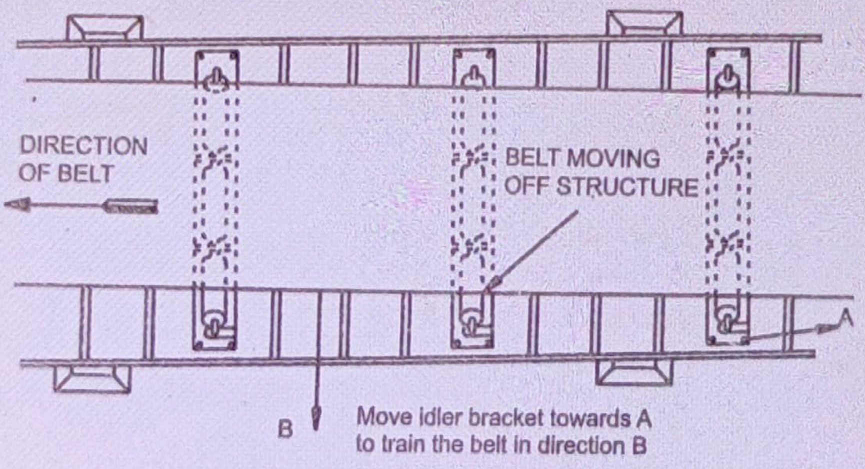
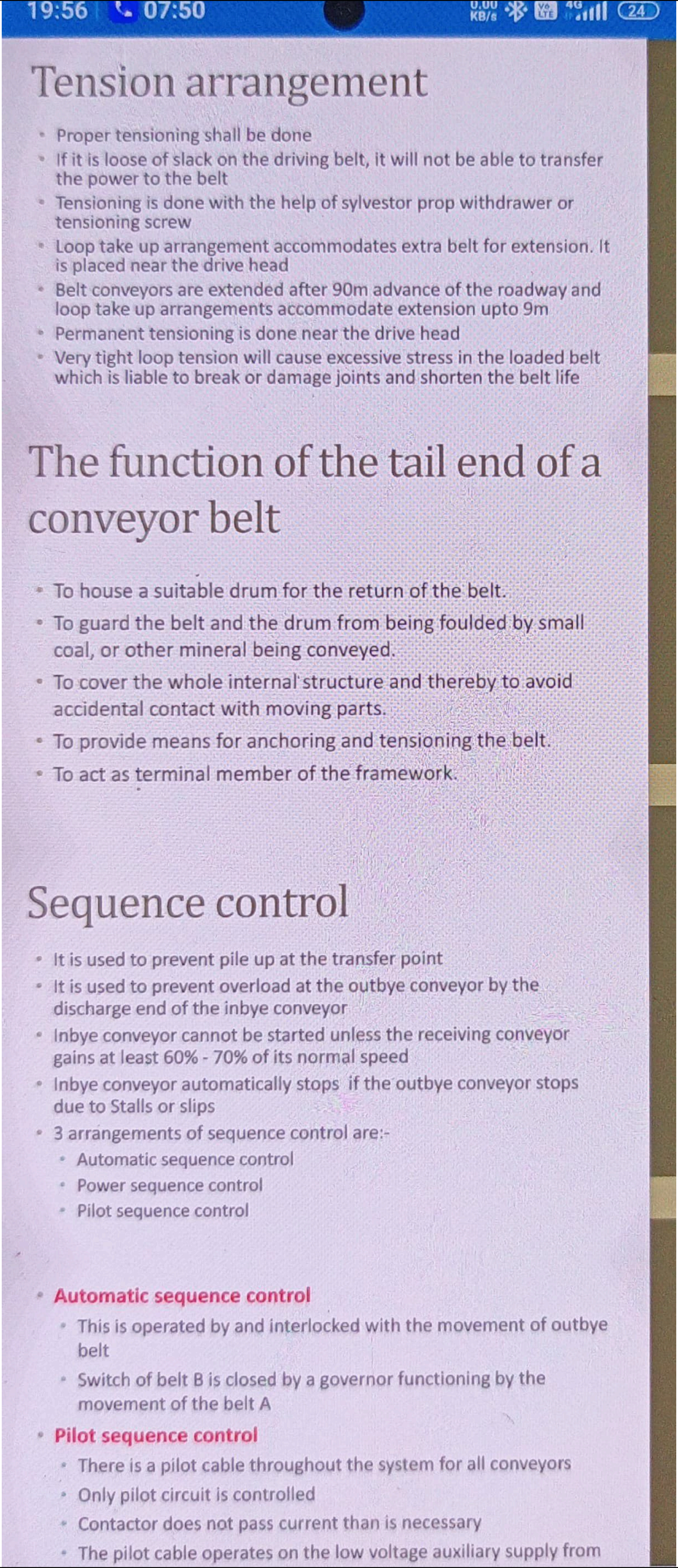

DIRECTION OF BELT
BELT MOVING OFF STRUCTURE
A
B
Move idler bracket towards A to train the belt in direction B

Fig. 17.6 Adjustment of idlers to course a wandering belt.

Tension arrangement

- Proper tensioning shall be done
- If it is loose of slack on the driving belt, it will not be able to transfer the power to the belt
- Tensioning is done with the help of sylvestor prop withdrawer or tensioning screw



Tension arrangement

- Proper tensioning shall be done
- If it is loose of slack on the driving belt, it will not be able to transfer the power to the belt
- Tensioning is done with the help of sylvestor prop withdrawer or tensioning screw
- Loop take up arrangement accommodates extra belt for extension. It is placed near the drive head
- Belt conveyors are extended after 90m advance of the roadway and loop take up arrangements accommodate extension upto 9m
- Permanent tensioning is done near the drive head
- Very tight loop tension will cause excessive stress in the loaded belt which is liable to break or damage joints and shorten the belt life

The function of the tail end of a conveyor belt

- To house a suitable drum for the return of the belt.
- To guard the belt and the drum from being foulded by small coal, or other mineral being conveyed.
- To cover the whole internal structure and thereby to avoid accidental contact with moving parts.
- To provide means for anchoring and tensioning the belt.
- To act as terminal member of the framework.

Sequence control

- It is used to prevent pile up at the transfer point
- It is used to prevent overload at the outbye conveyor by the discharge end of the inbye conveyor
- Inbye conveyor cannot be started unless the receiving conveyor gains at least 60% - 70% of its normal speed
- Inbye conveyor automatically stops if the outbye conveyor stops due to Stalls or slips
- 3 arrangements of sequence control are:-
  - Automatic sequence control
  - Power sequence control
  - Pilot sequence control

- **Automatic sequence control**
  - This is operated by and interlocked with the movement of outbye belt
  - Switch of belt B is closed by a governor functioning by the movement of the belt A
- **Pilot sequence control**
  - There is a pilot cable throughout the system for all conveyors
  - Only pilot circuit is controlled
  - Contactor does not pass current than is necessary
  - The pilot cable operates on the low voltage auxiliary supply from

- 3 arrangements of sequence control are:-
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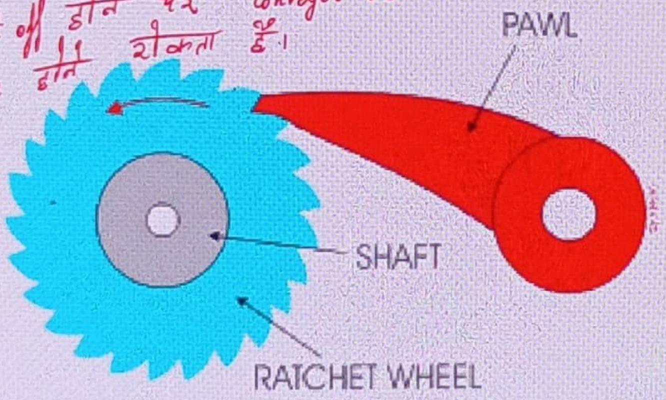
  - There is a pilot cable throughout the system for all conveyors
  - Only pilot circuit is controlled
  - Contactor does not pass current than is necessary
  - The pilot cable operates on the low voltage auxiliary supply from one control switch to another

Hold backs → safety device.
↓
Power cut off होने पर conveyor belt को backward direction मे move होने रोकता है।


PAWL
SHAFT
RATCHET WHEEL

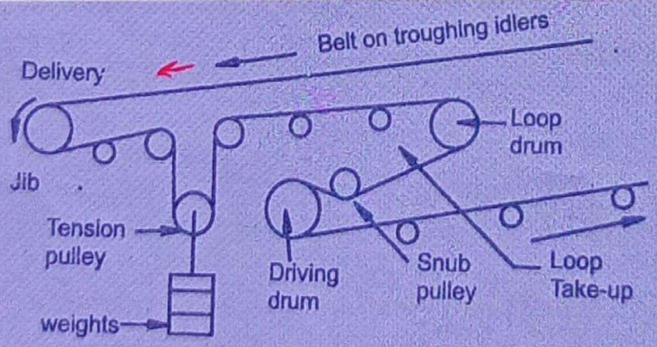
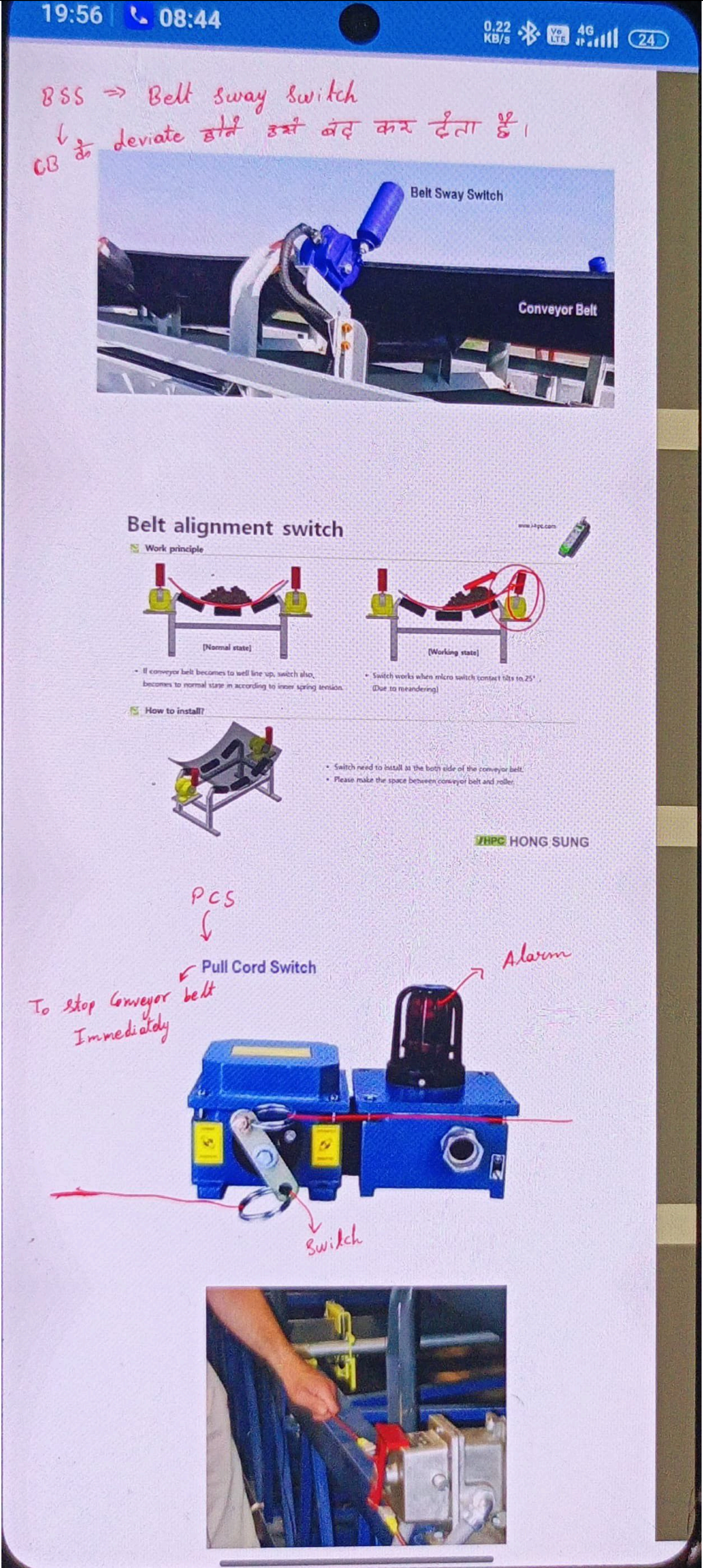

Delivery
Belt on troughing idlers
Loop drum
Jib
Tension pulley
weights
Driving drum
Snub pulley
Loop Take-up

Fig. 17.8. Arrangement of drive motor, loop take-up and tensioning weights on a belt conveyor discharging down hill.

BSS ⇒ Belt Sway Switch
↓
CB के deviate होने इसे बंद कर देता है।

Belt Sway Switch


19:56
08:44
0.22 KB/s
4G
24

BSS ⇒ Belt Sway Switch
↓
CB के deviate होने इसे बंद कर देता है।

Belt Sway Switch
Conveyor Belt

Belt alignment switch

www.i-hpc.com

Work principle

[Normal state]
[Working state]

- If conveyor belt becomes to well line up, switch also, becomes to normal state in according to inner spring tension.
- Switch works when micro switch contact tilts to 25°. (Due to meandering)

How to install?

- Switch need to install as the both side of the conveyor belt.
- Please make the space between conveyor belt and roller.

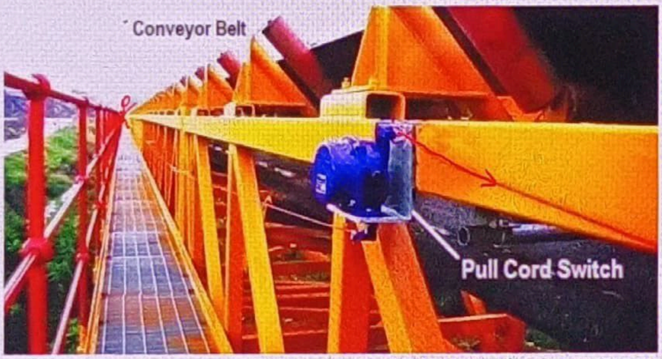
HPC HONG SUNG

PCS
↓
Pull Cord Switch

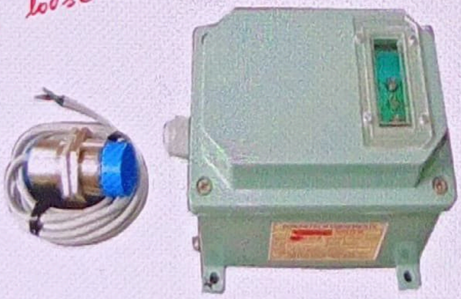
To stop Conveyor belt Immediately

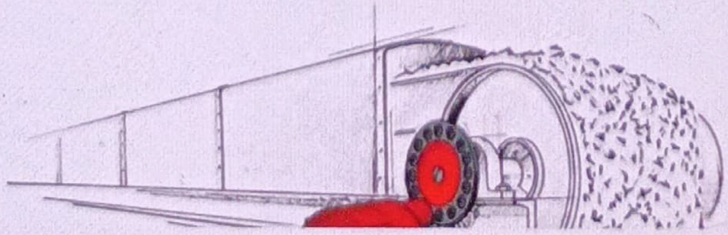
Alarm

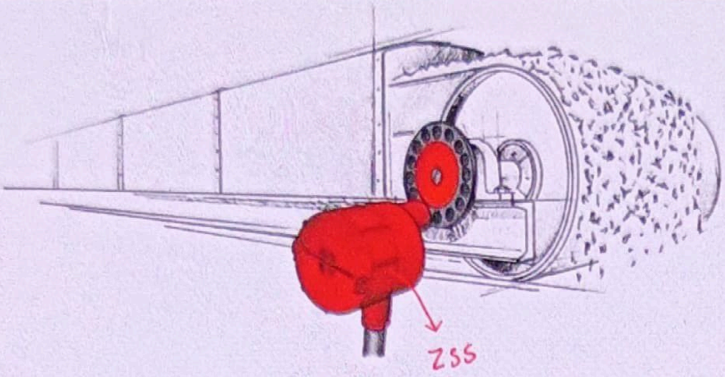
Switch

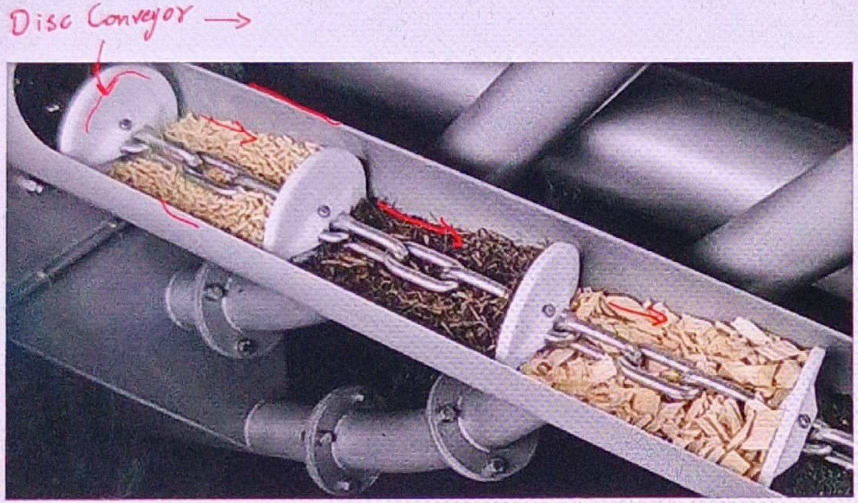

Conveyor Belt
Pull Cord Switch

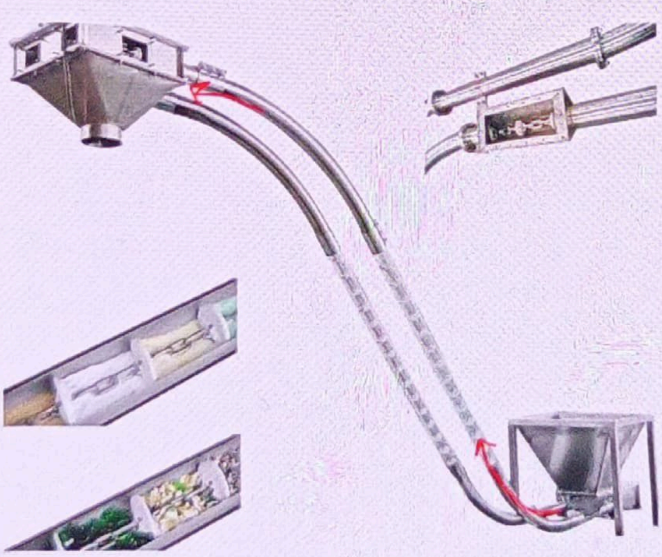
ZSS → Zero Speed switch.
↓
gives warning if conveyor belt is loose

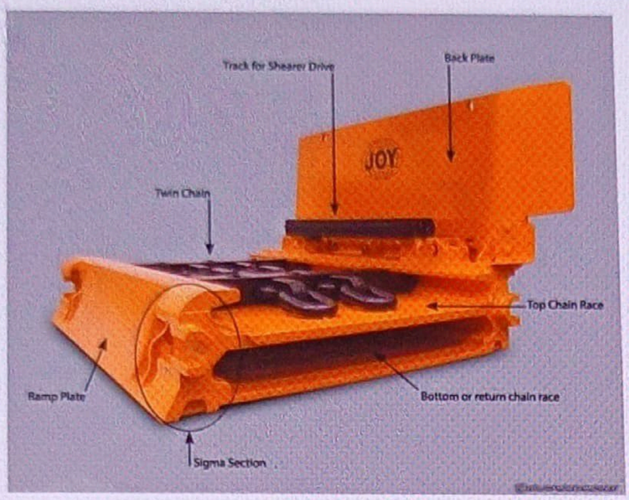




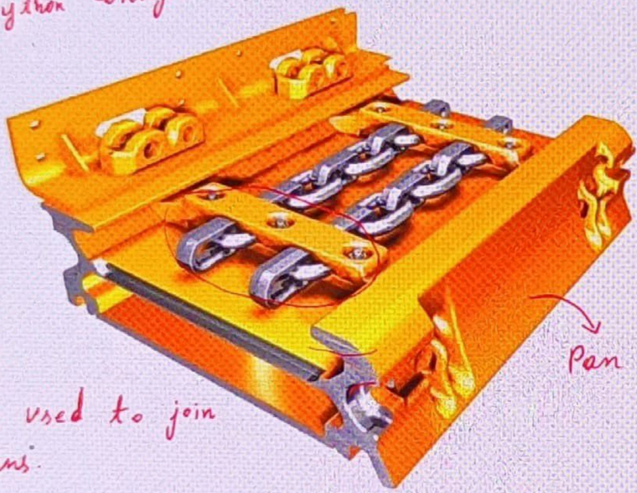

ZSS


Disc Conveyor →



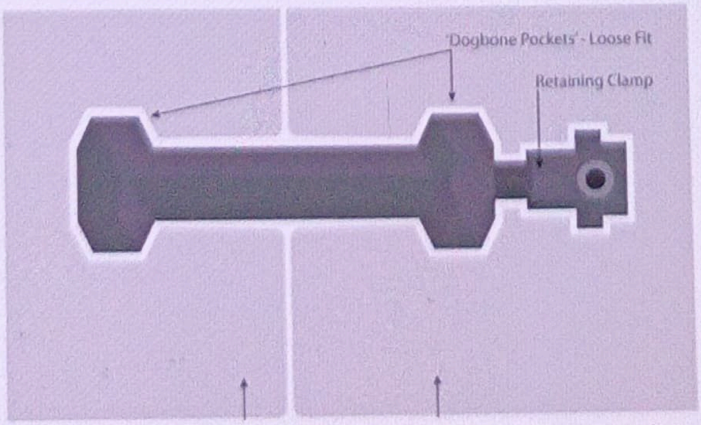

Track for Shearer Drive
Back Plate
JOY
Twin Chain
Top Chain Race
Ramp Plate
Bottom or return chain race
Sigma Section

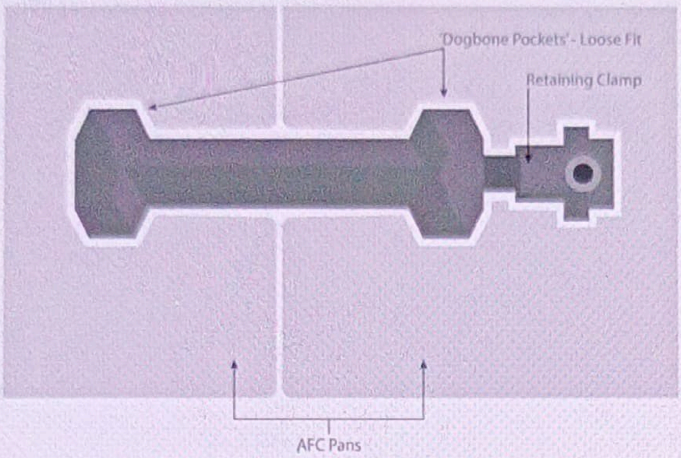
AFC → Python Conveyor.



Pan

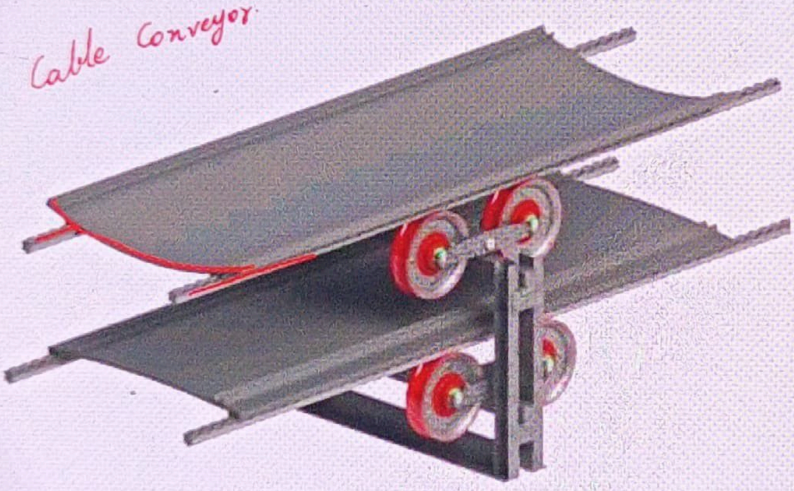
Dog bone is used to join Two Pans.

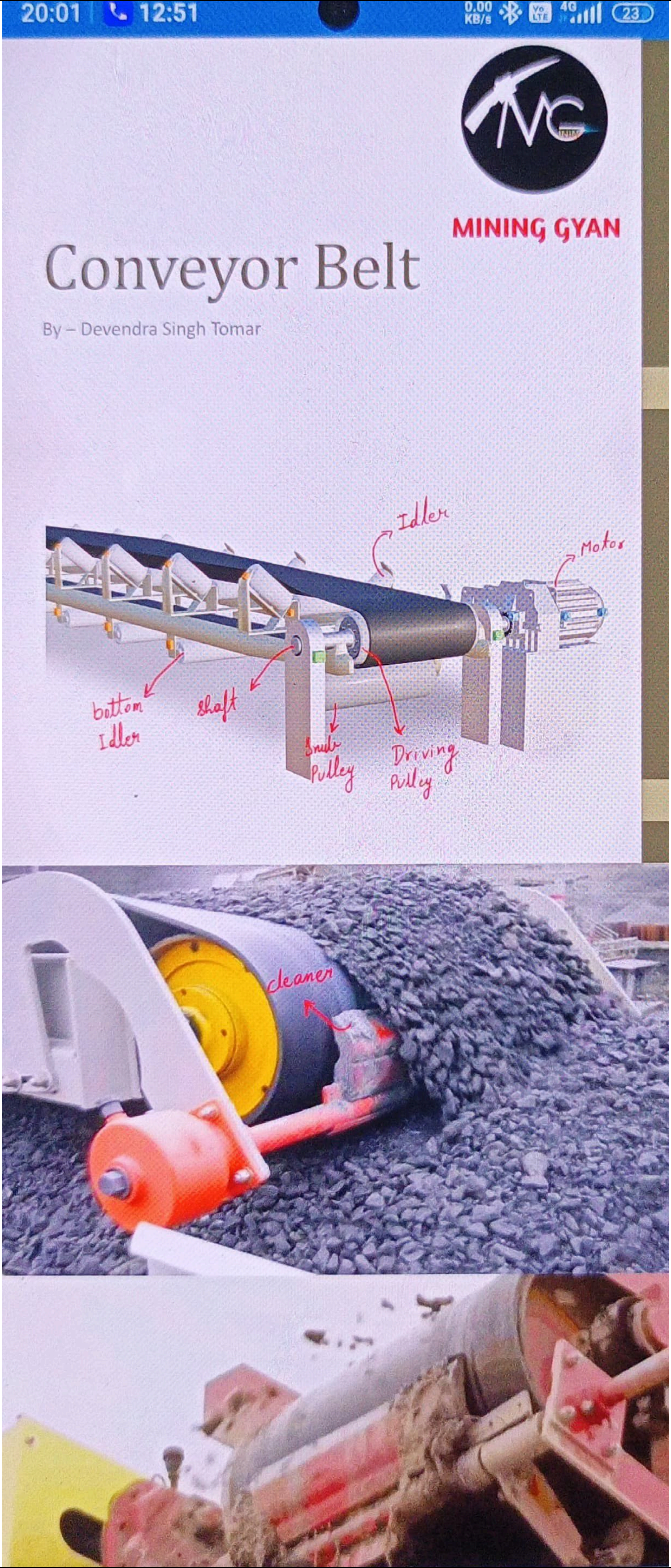

'Dogbone Pockets' - Loose Fit
Retaining Clamp


'Dogbone Pockets' - Loose Fit
Retaining Clamp
AFC Pans

'Dogbone' or 'Dumbell' Connector

Cable Conveyor





20:01
12:51
0.00 KB/s
4G
23

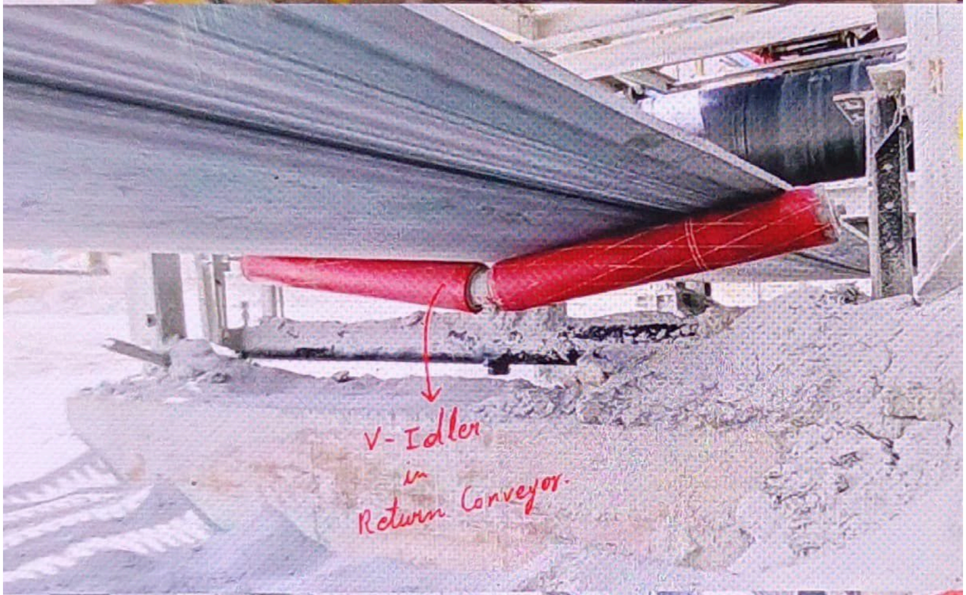
MINING GYAN

Conveyor Belt

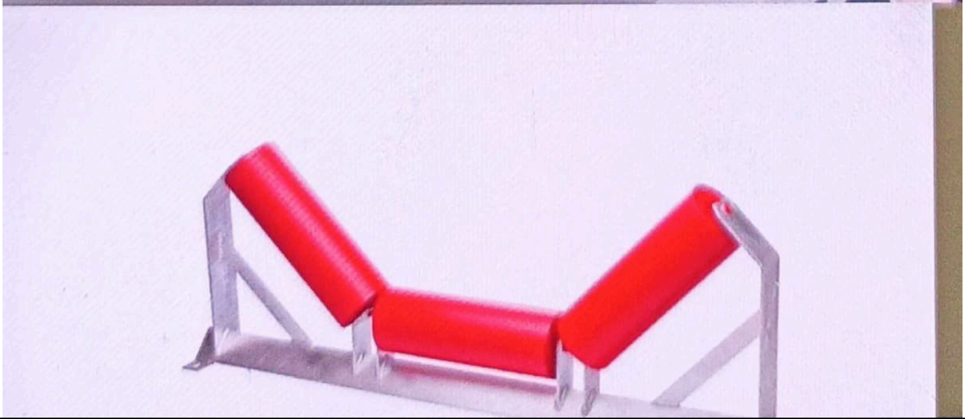
By – Devendra Singh Tomar

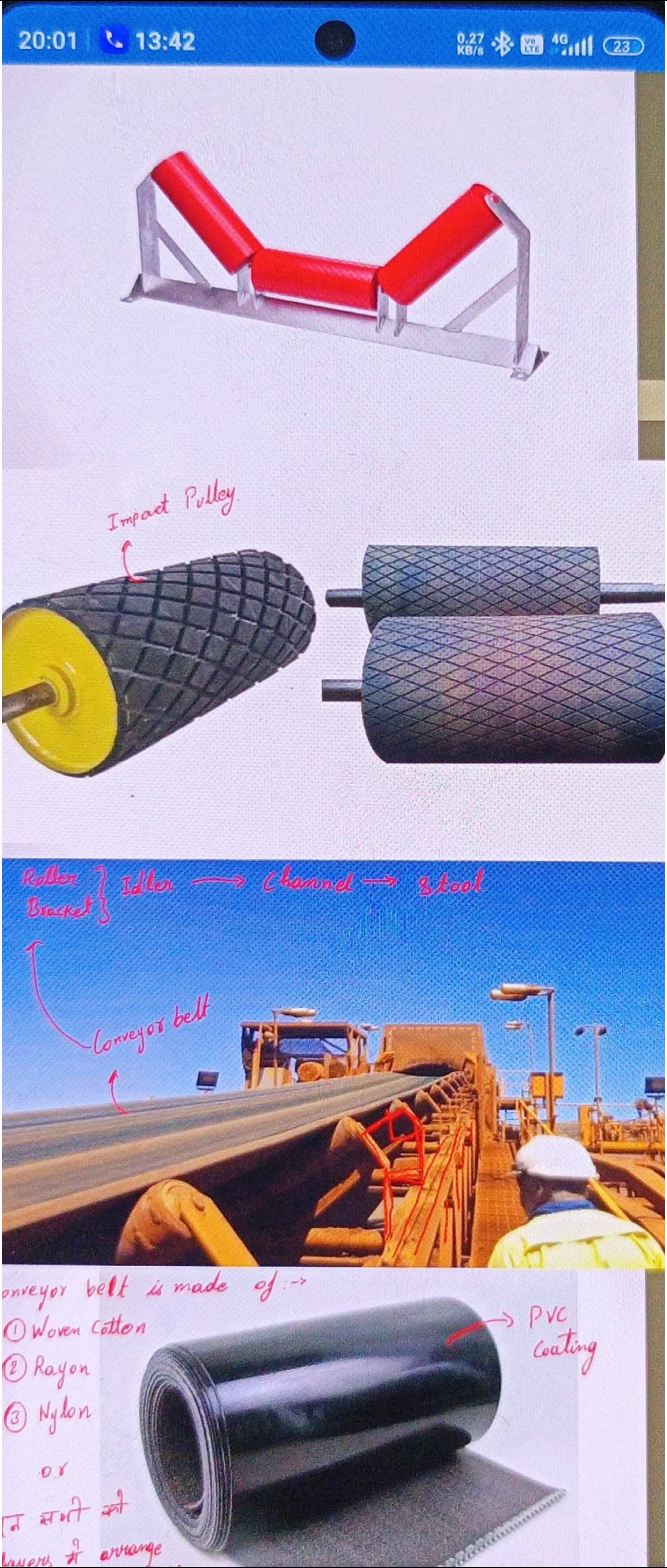
Idler
Motor
bottom Idler
Shaft
Snub Pulley
Driving Pulley
cleaner

20:01
13:19
0.37 KB/s
4G
23



V- Idler
in
Return Conveyor.




20:01
13:42
0.27 KB/s
4G
23
Impact Pulley
Roller
Bracket
Idler → Channel → Stool
Conveyor belt
PVC Coating

onveyor belt is made of :->

① Woven Cotton

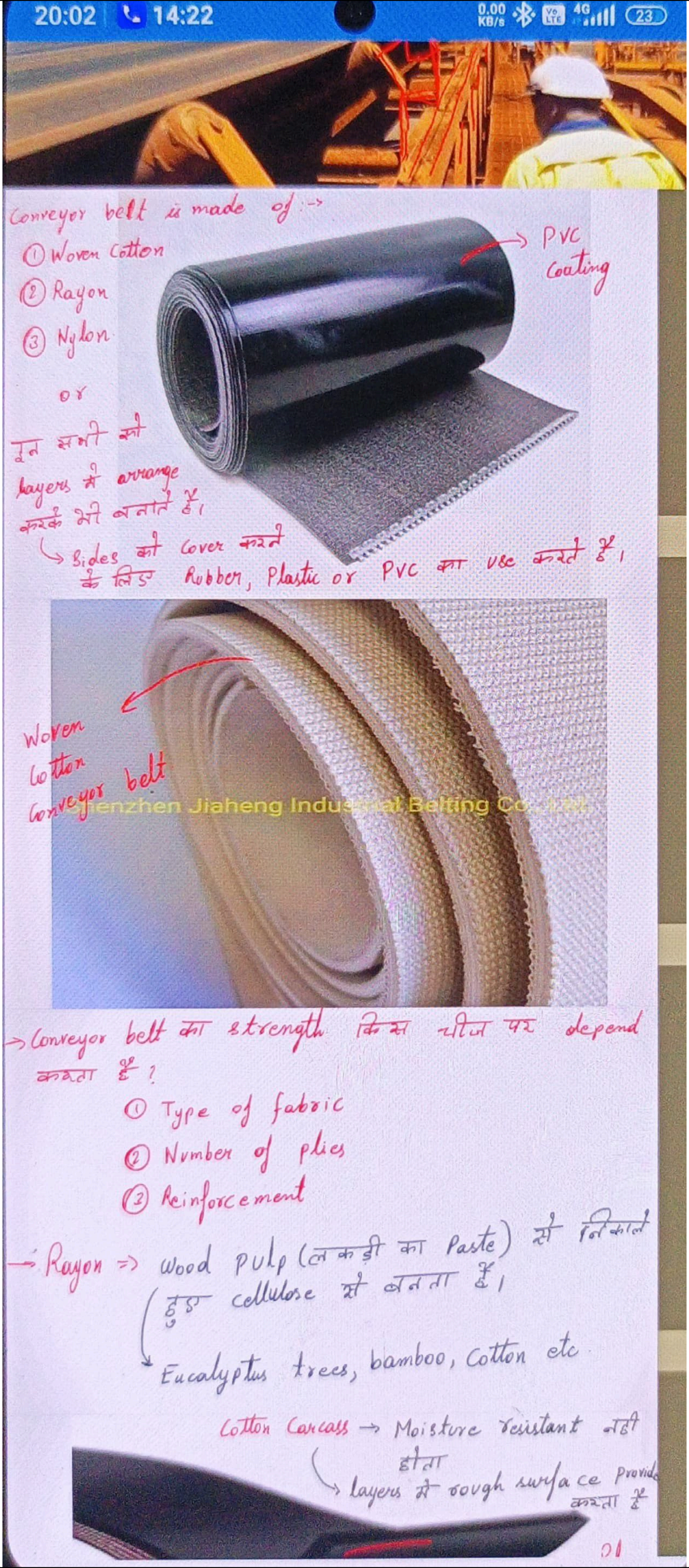
② Rayon

③ Nylon

or

न सभी को

layers में arrange


20:02
14:22
0.00 KB/s
4G
23
Shenzhen Jiaheng Industrial Belting Co., Ltd.

Conveyor belt is made of :→

① Woven Cotton

② Rayon

③ Nylon

or

इन सभी को layers में arrange करके भी बनाते हैं।

↳ Sides को cover करने के लिए Rubber, Plastic or PVC का use करते हैं।

→ PVC Coating

Woven Cotton Conveyor belt

→ Conveyor belt का strength किस चीज पर depend करता है ?

① Type of fabric

② Number of plies

③ Reinforcement

→ Rayon ⇒ wood pulp (लकड़ी का Paste) से निकाले हुए cellulose से बनता है।

↳ Eucalyptus trees, bamboo, Cotton etc

Cotton Carcass → Moisture resistant नहीं होता

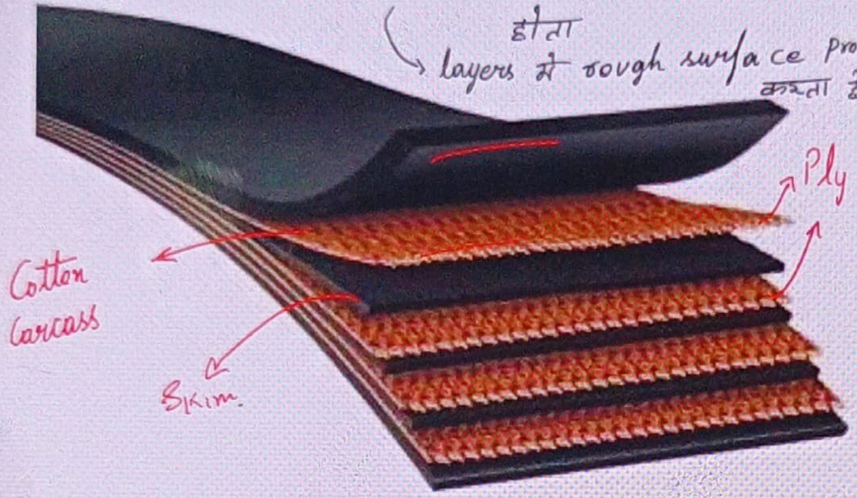
↳ layers में rough surface Provid करता है

01

(2) Reinforcement

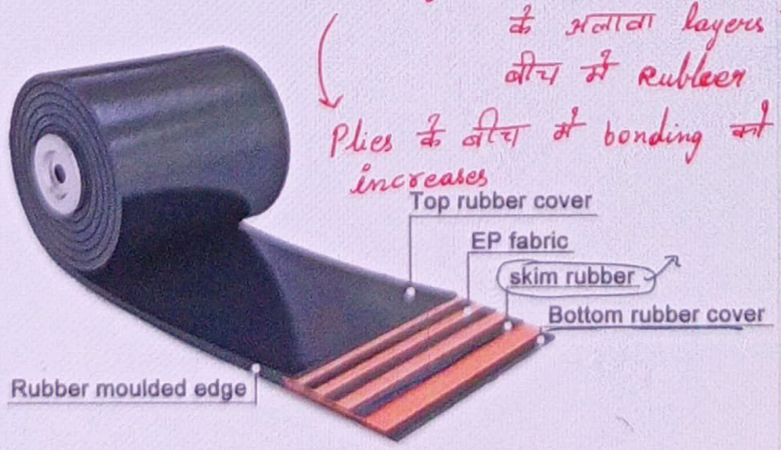
- Rayon => wood pulp (लकड़ी का Paste) से निकाले हुए cellulose से बनता है।
  ↳ Eucalyptus trees, bamboo, cotton etc.

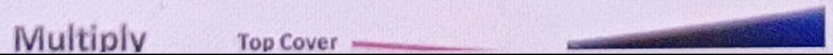
Cotton Carcass → Moisture resistant नहीं होता
↳ layers में rough surface provide करता है

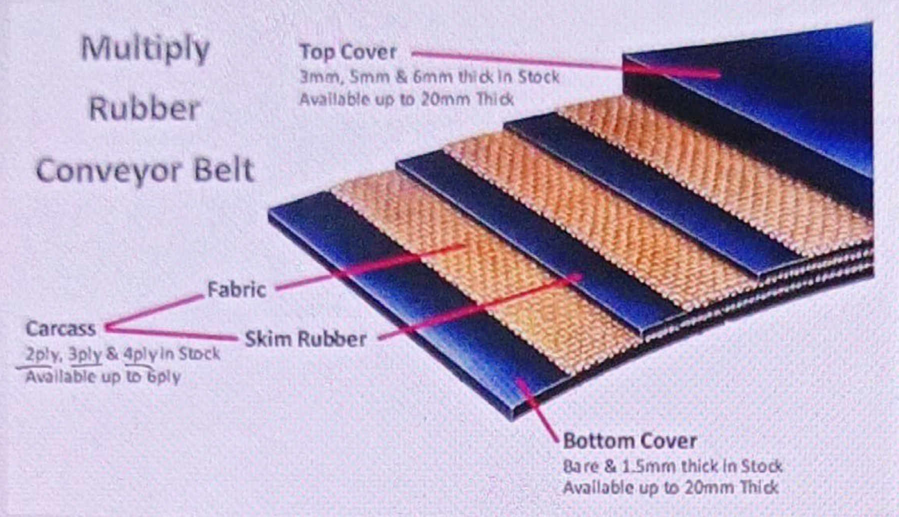

Ply
Cotton Carcass
Skim

- Nylon => highly Pressurized coal & petroleum में पाए जाने वाले carbon based chemical reactions से बनता है।
  ↳ Nylon family के materials को Polyamides कहते हैं।
  - → Longitudinal tearing में strong resistance देता है।
  - → Impact damage को resist करता है
  - → fastners को अच्छे से hold करता है

Skim Coating → Top & bottom rubber के अलावा layers के बीच में Rubber
↳ Plies के बीच में bonding को increases


Top rubber cover
EP fabric
skim rubber
Bottom rubber cover
Rubber moulded edge


Multiply
Top Cover


Multiply Rubber Conveyor Belt
Top Cover
3mm, 5mm & 6mm thick in Stock
Available up to 20mm Thick
Fabric
Carcass
2ply, 3ply & 4ply in Stock
Available up to 6ply
Skim Rubber
Bottom Cover
Bare & 1.5mm thick in Stock
Available up to 20mm Thick

PVC → Poly Vinyl Chloride

→ यह fireproof होता है।

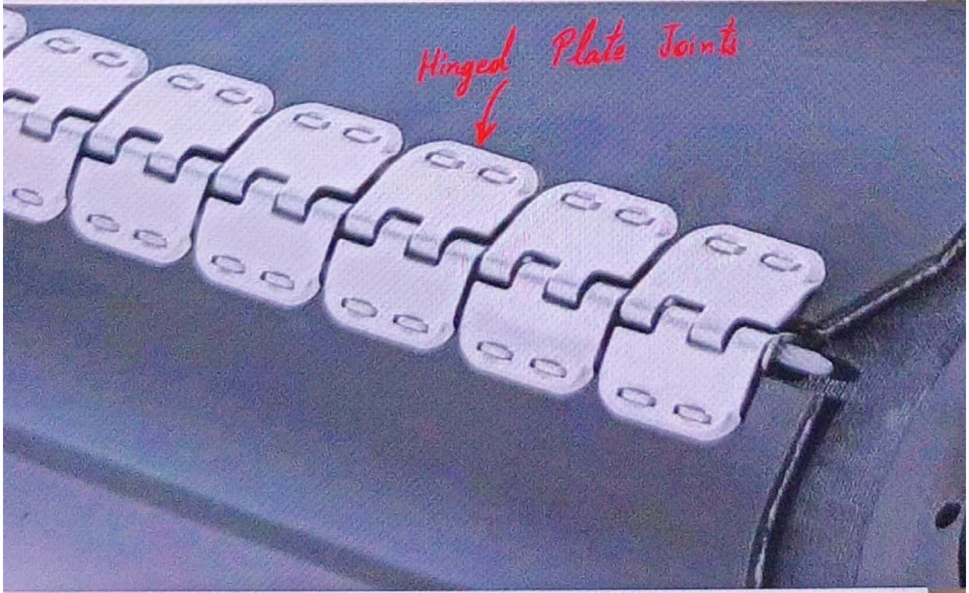
→ PVC coated belts shall be Used in UG Coal mines.

→ Resistant to grease & oil

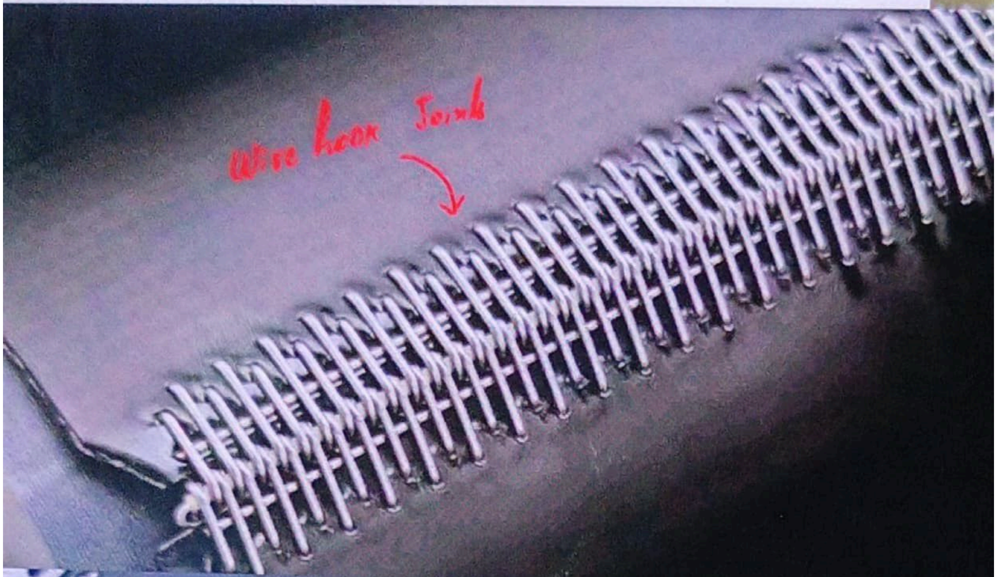
→ Friction कम होता है जिसके इसे steep gradients में use नही कर सकते है।

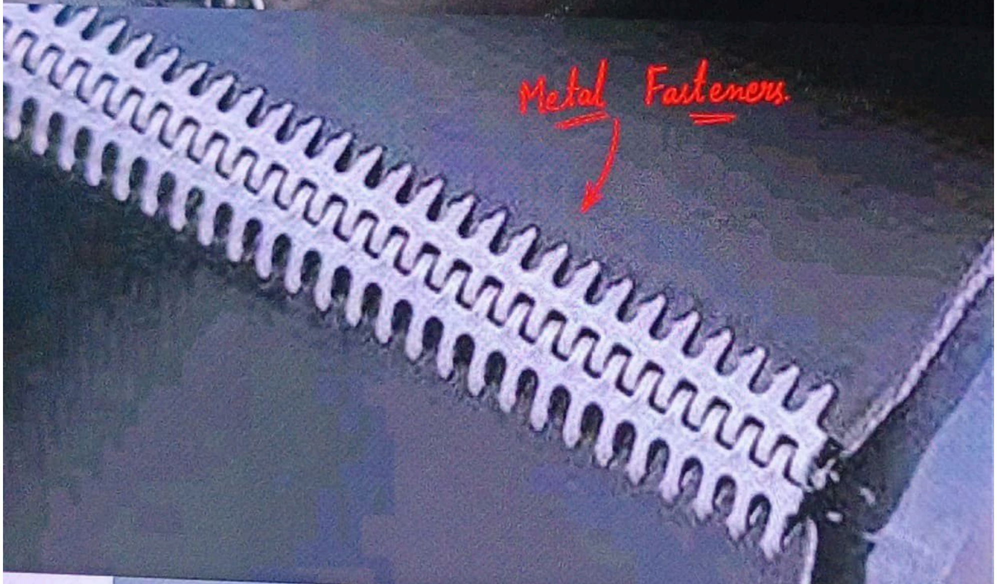
→ Gradient shall not be more than 16°

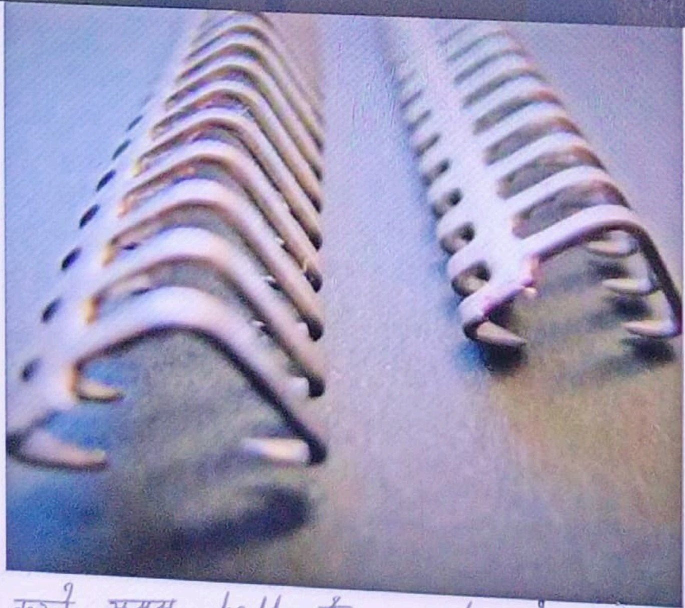
→ Rubber
  → without brake → Gradient → 1 in 5
  → with brake → 1 in 3


Hinged Plate Joints

Belts are joined by ⇒ ① Hinged Plate Joints
② Wire hook Joints
③ Metal fasteners for joining PVC belts.


Wire hook Joints


Metal Fasteners



→ Join करते समय belt के ends को Vulcanize करना है → Special heat press करना
↳ Vulcanization.

[illegible] → 0.6m)

→ Join करते समय belt के ends को Vulcanize करना है → special heat press करना
↳ Vulcanization.

→ Belt Width → face conveyor → 0.6m
Trunk Conveyor → 1m in } UG Coal Mine
Surface Installations → 1.2m.
Maximum width → 1.5m

Troughed Belt Carrying Capacity.

→ if speed of belt is 30m/min

Belt width → Te/hr.

→ 650mm → face or gate Conveyor → 50

→ 750mm → " " " → 70

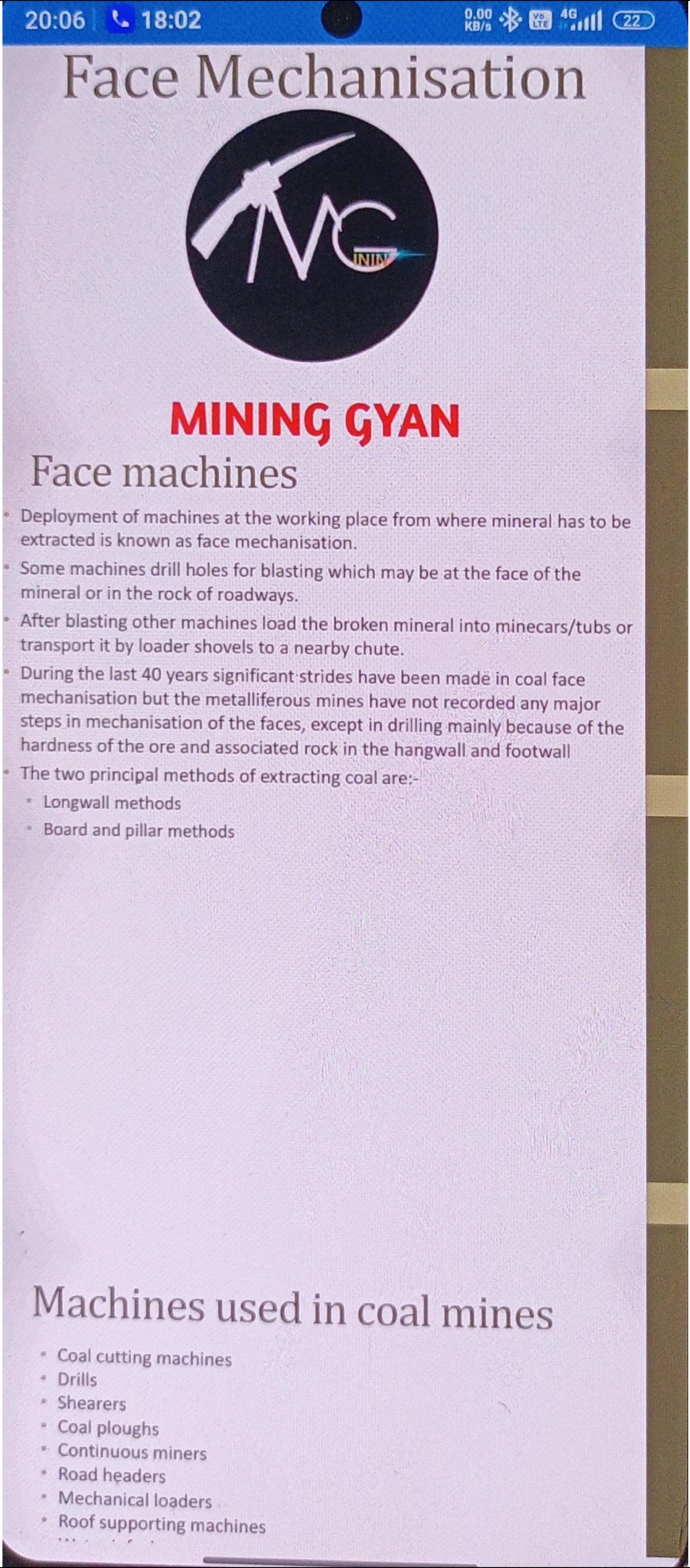
→ 1000mm → Trunk Conveyor → 105

→ speed double करने पर capacity double हो जाएगी

→ अगर feed uniform नहीं है तो capacity 30% से 60% ही बचेगी

→ Troughed belt के मुकाबले flat belt की capacity 50% होती है।

→ Maximum lump size carried by belt Conveyor.
↳ half the width of belt.



Face Mechanisation

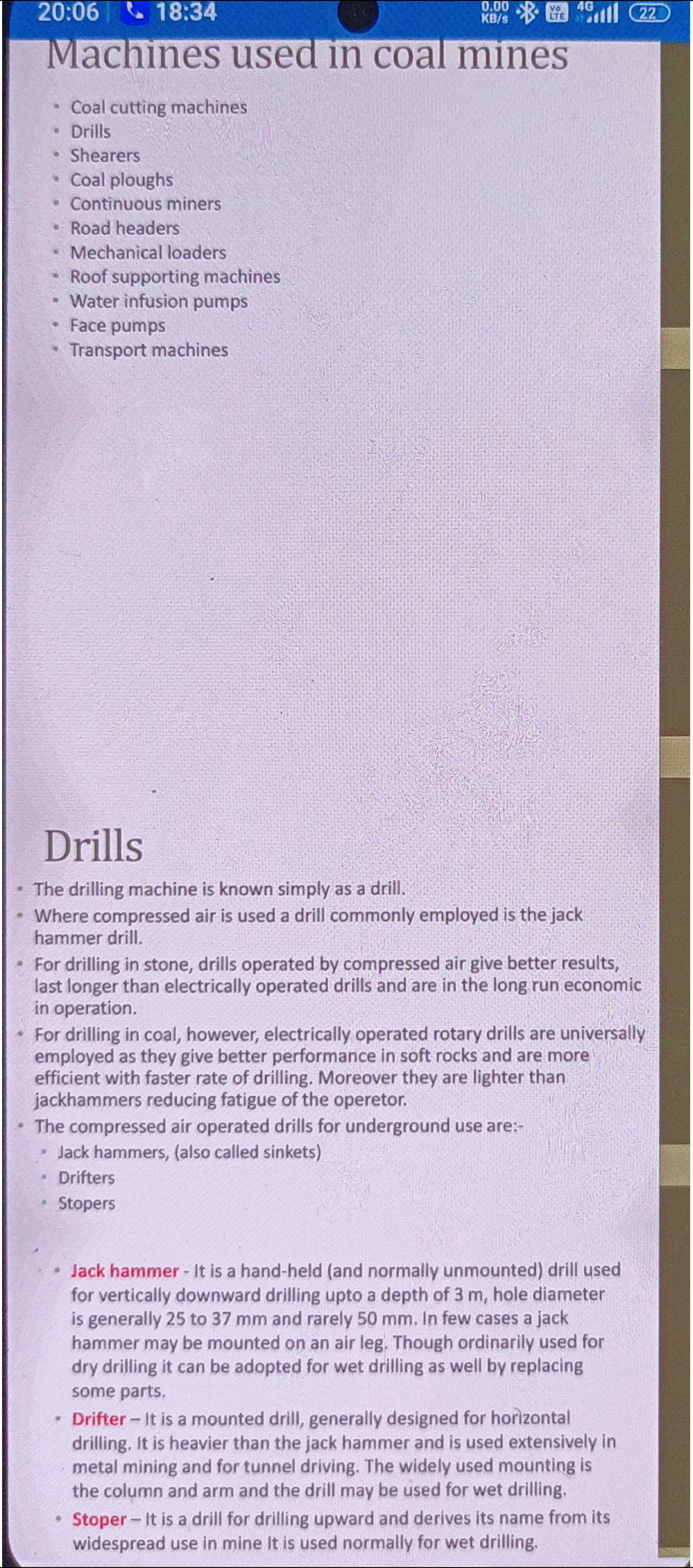
MINING GYAN

Face machines

- Deployment of machines at the working place from where mineral has to be extracted is known as face mechanisation.
- Some machines drill holes for blasting which may be at the face of the mineral or in the rock of roadways.
- After blasting other machines load the broken mineral into minecars/tubs or transport it by loader shovels to a nearby chute.
- During the last 40 years significant strides have been made in coal face mechanisation but the metalliferous mines have not recorded any major steps in mechanisation of the faces, except in drilling mainly because of the hardness of the ore and associated rock in the hangwall and footwall
- The two principal methods of extracting coal are:-
  - Longwall methods
  - Board and pillar methods

Machines used in coal mines

- Coal cutting machines
- Drills
- Shearers
- Coal ploughs
- Continuous miners
- Road headers
- Mechanical loaders
- Roof supporting machines



Machines used in coal mines

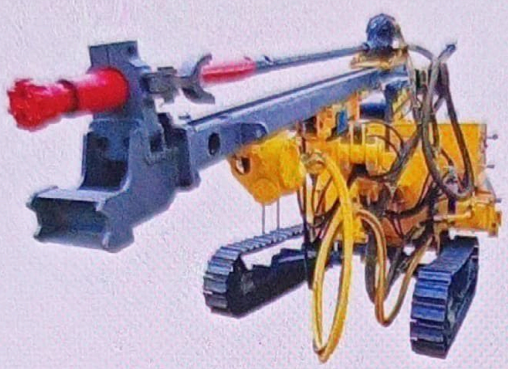
- Coal cutting machines
- Drills
- Shearers
- Coal ploughs
- Continuous miners
- Road headers
- Mechanical loaders
- Roof supporting machines
- Water infusion pumps
- Face pumps
- Transport machines

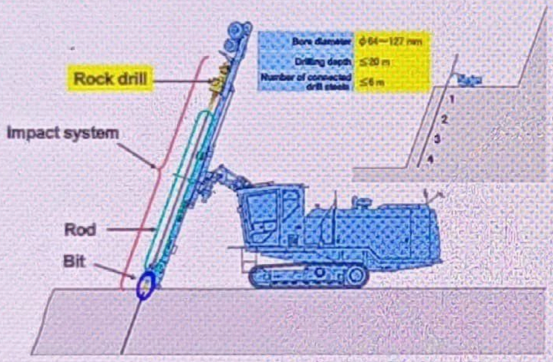
Drills

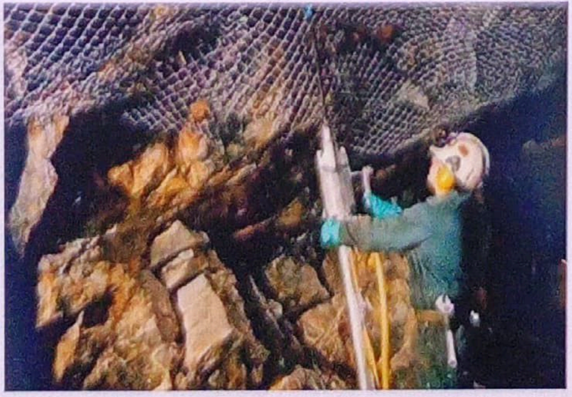
- The drilling machine is known simply as a drill.
- Where compressed air is used a drill commonly employed is the jack hammer drill.
- For drilling in stone, drills operated by compressed air give better results, last longer than electrically operated drills and are in the long run economic in operation.
- For drilling in coal, however, electrically operated rotary drills are universally employed as they give better performance in soft rocks and are more efficient with faster rate of drilling. Moreover they are lighter than jackhammers reducing fatigue of the operetor.
- The compressed air operated drills for underground use are:-
  - Jack hammers, (also called sinkets)
  - Drifters
  - Stopers

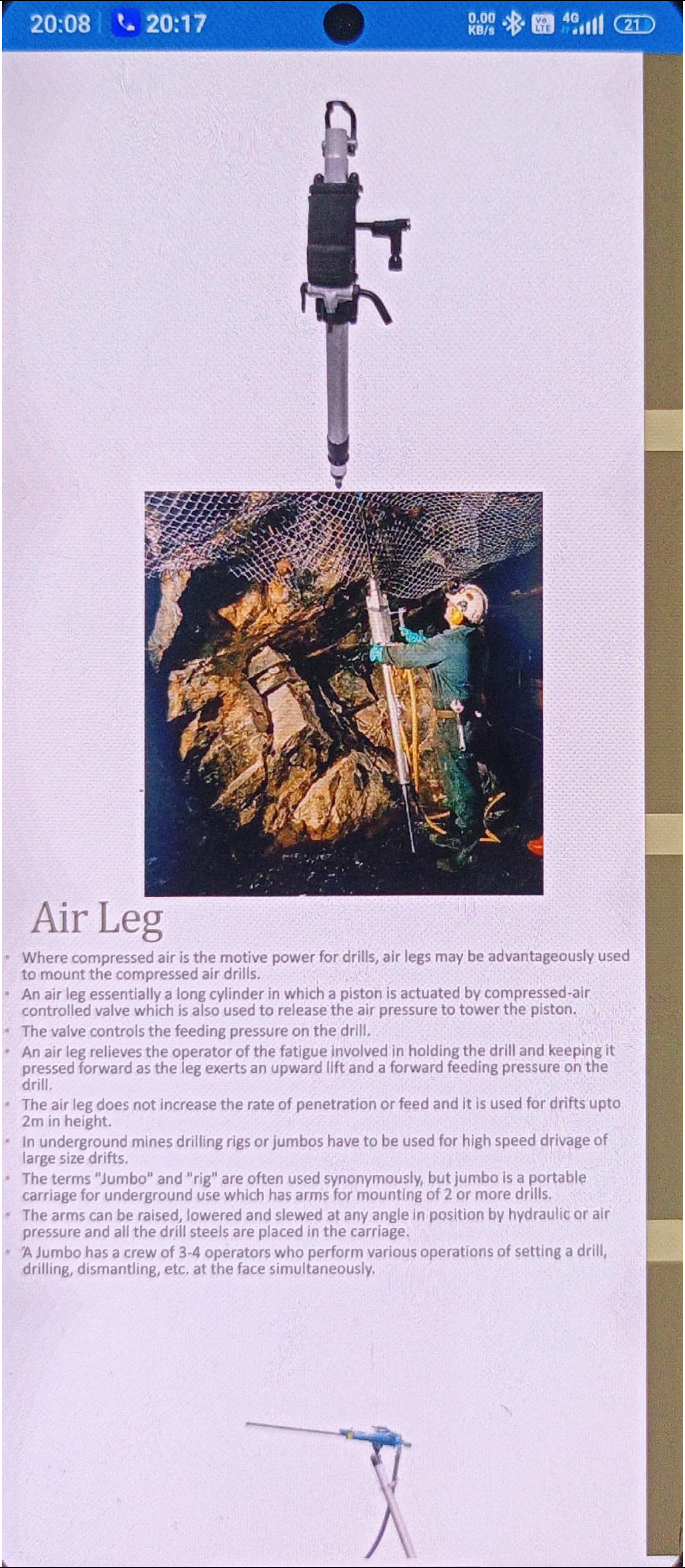
- **Jack hammer** - It is a hand-held (and normally unmounted) drill used for vertically downward drilling upto a depth of 3 m, hole diameter is generally 25 to 37 mm and rarely 50 mm. In few cases a jack hammer may be mounted on an air leg. Though ordinarily used for dry drilling it can be adopted for wet drilling as well by replacing some parts.
- **Drifter** – It is a mounted drill, generally designed for horizontal drilling. It is heavier than the jack hammer and is used extensively in metal mining and for tunnel driving. The widely used mounting is the column and arm and the drill may be used for wet drilling.
- **Stoper** – It is a drill for drilling upward and derives its name from its widespread use in mine It is used normally for wet drilling.

BRUTE
BOSCH




Rock drill
Impact system
Rod
Bit
Bore diameter
ϕ 64~127 mm
Drilling depth
≤20 m
Number of connected drill steels
≤6 m
1
2
3
4





Air Leg

- Where compressed air is the motive power for drills, air legs may be advantageously used to mount the compressed air drills.
- An air leg essentially a long cylinder in which a piston is actuated by compressed-air controlled valve which is also used to release the air pressure to tower the piston.
- The valve controls the feeding pressure on the drill.
- An air leg relieves the operator of the fatigue involved in holding the drill and keeping it pressed forward as the leg exerts an upward lift and a forward feeding pressure on the drill.
- The air leg does not increase the rate of penetration or feed and it is used for drifts upto 2m in height.
- In underground mines drilling rigs or jumbos have to be used for high speed drivage of large size drifts.
- The terms "Jumbo" and "rig" are often used synonymously, but jumbo is a portable carriage for underground use which has arms for mounting of 2 or more drills.
- The arms can be raised, lowered and slewed at any angle in position by hydraulic or air pressure and all the drill steels are placed in the carriage.
- A Jumbo has a crew of 3-4 operators who perform various operations of setting a drill, drilling, dismantling, etc. at the face simultaneously.

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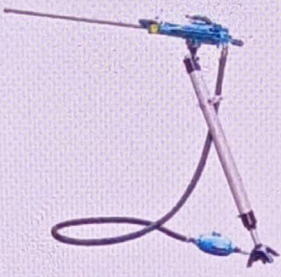
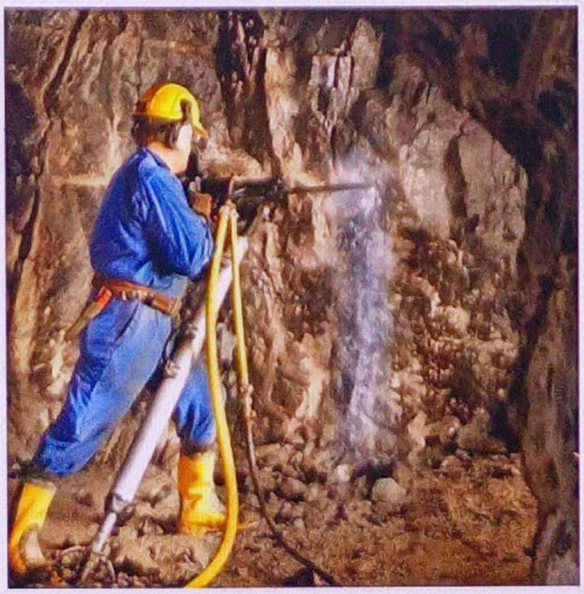
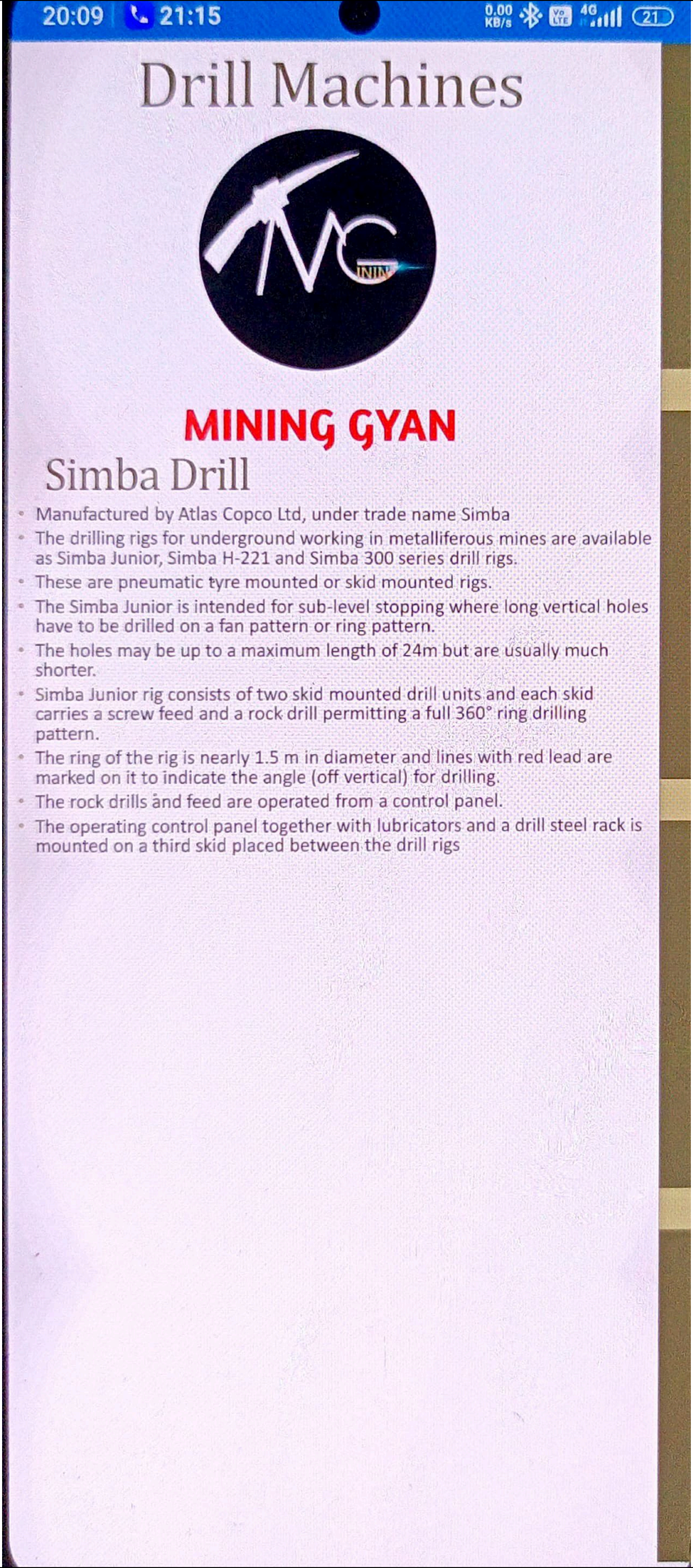






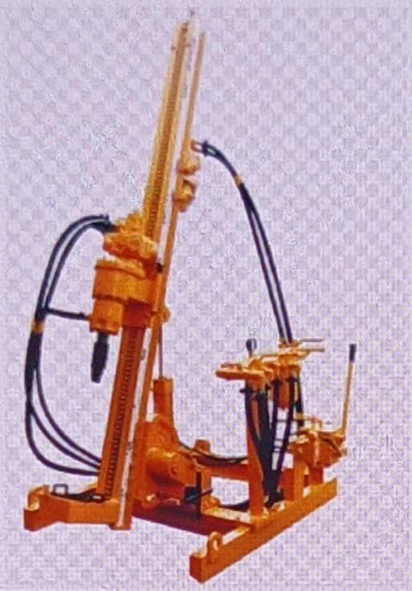
Drill Machines

MINING GYAN

Simba Drill

- Manufactured by Atlas Copco Ltd, under trade name Simba
- The drilling rigs for underground working in metalliferous mines are available as Simba Junior, Simba H-221 and Simba 300 series drill rigs.
- These are pneumatic tyre mounted or skid mounted rigs.
- The Simba Junior is intended for sub-level stopping where long vertical holes have to be drilled on a fan pattern or ring pattern.
- The holes may be up to a maximum length of 24m but are usually much shorter.
- Simba Junior rig consists of two skid mounted drill units and each skid carries a screw feed and a rock drill permitting a full 360° ring drilling pattern.
- The ring of the rig is nearly 1.5 m in diameter and lines with red lead are marked on it to indicate the angle (off vertical) for drilling.
- The rock drills and feed are operated from a control panel.
- The operating control panel together with lubricators and a drill steel rack is mounted on a third skid placed between the drill rigs

- The Simba Junior Special is based on the same principles as Simba Junior rig, but it consists of one skid mounted drill unit and a second skid equipped with the controls, lubricators and the drill steel rack.
- The Simba H221 is a mechanised hydraulic drilling rig level stopping and is also designed for ring drilling (360°) in sub level stoping.
- The chassis for Simba H221 is hydraulically powered and is fitted with a hydraulic system for rock drill (type COP 1038 HL) for long hole drilling.
- All feed movements are performed by hydraulic cylinders which are operated from a control panel on the feed holder.
- The feed is a screw feed powered by a hydraulic motor.
- The crew for the rig consists of an operator and two helpers.
- Simba H221 can be equipped with an electric remote control system for all rock drill operations.
- Atlas Copco's rock drill COP 131 EL and BBC 120 F mounted on a screw feed are suitable for longhole drilling with 50 mm drilling bit and these are used on Simba drill rigs.



Cavo drills

- These are light drill rigs for UG drilling
- It incorporates the pneumatic traction unit from cavo 500 loader and two booms
- Specifications
  - Gross weight – 6950kgf
  - Total length – 8.83m
  - Total width – 1.8m
  - Travelling speed – 3.6km/hr
  - Climbing ability – 1:6 gradient

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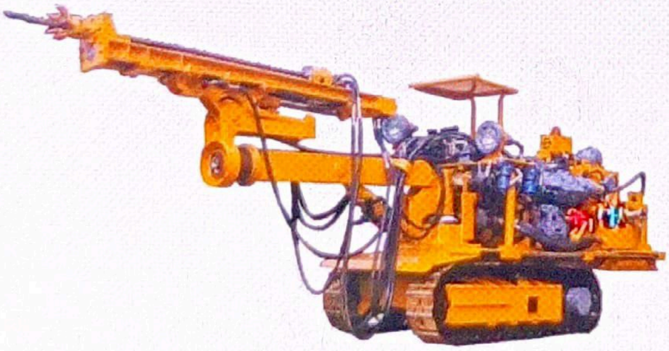
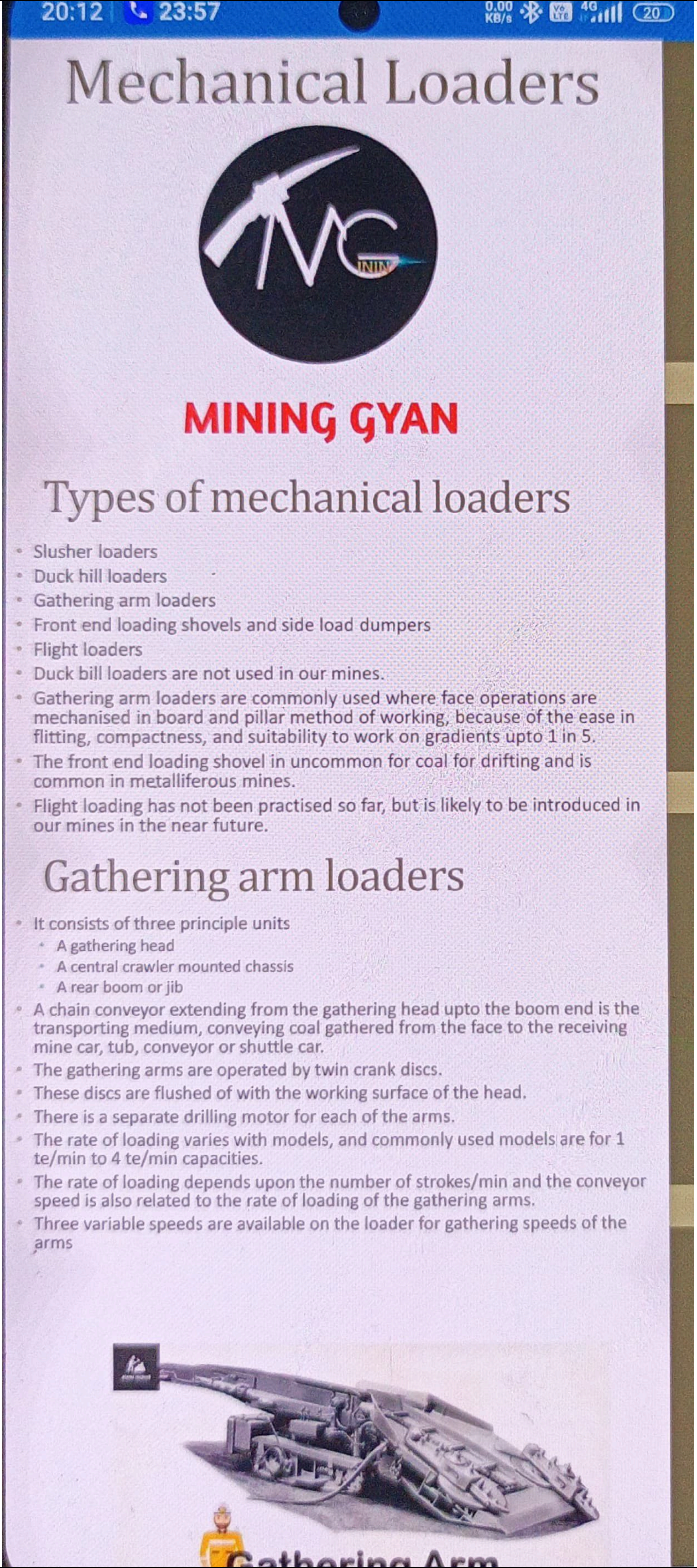
FY300A水井钻机





Mechanical Loaders

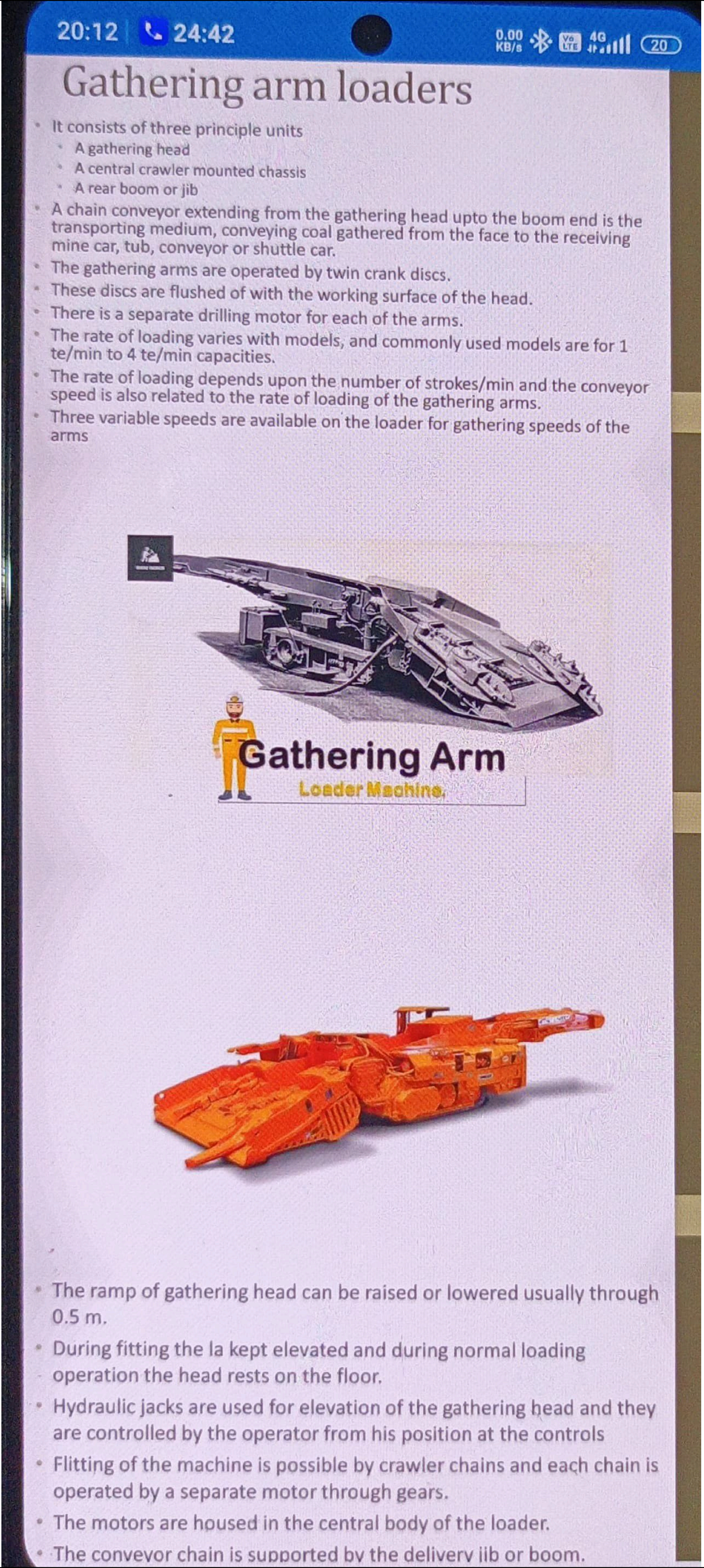
MINING GYAN

Types of mechanical loaders

- Slusher loaders
- Duck hill loaders
- Gathering arm loaders
- Front end loading shovels and side load dumpers
- Flight loaders
- Duck bill loaders are not used in our mines.
- Gathering arm loaders are commonly used where face operations are mechanised in board and pillar method of working, because of the ease in flitting, compactness, and suitability to work on gradients upto 1 in 5.
- The front end loading shovel in uncommon for coal for drifting and is common in metalliferous mines.
- Flight loading has not been practised so far, but is likely to be introduced in our mines in the near future.

Gathering arm loaders

- It consists of three principle units
  - A gathering head
  - A central crawler mounted chassis
  - A rear boom or jib
- A chain conveyor extending from the gathering head upto the boom end is the transporting medium, conveying coal gathered from the face to the receiving mine car, tub, conveyor or shuttle car.
- The gathering arms are operated by twin crank discs.
- These discs are flushed of with the working surface of the head.
- There is a separate drilling motor for each of the arms.
- The rate of loading varies with models, and commonly used models are for 1 te/min to 4 te/min capacities.
- The rate of loading depends upon the number of strokes/min and the conveyor speed is also related to the rate of loading of the gathering arms.
- Three variable speeds are available on the loader for gathering speeds of the arms



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- The ramp of gathering head can be raised or lowered usually through 0.5 m.
- During fitting the la kept elevated and during normal loading operation the head rests on the floor.
- Hydraulic jacks are used for elevation of the gathering head and they are controlled by the operator from his position at the controls
- Flitting of the machine is possible by crawler chains and each chain is operated by a separate motor through gears.
- The motors are housed in the central body of the loader.
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- The conveyor chain is supported by the delivery jib or boom.
- This jib end, and along with it the conveyor can be raised or lowered through a vertical range of 0.6 to 0.9 m by hydraulic picks.

- The jib can also be slewed through a horizontal plane so as to make an angle of 45° to the axis of the machine on either side.
- This enables the conveyor to discharge coal on either side of the centre line of the loader.
- The slewing is possible with the help of either-tension ropes or jacks hydraulically operated by oil
- At the face, as the loader loads coal it has to move forward to be close to coal heap and in a gallery width of 4 to 4.8 m to and fro movements of the machine are frequent for clearing up the gallery.
- Clearing up the last remains of the face coal usually takes a long time.
- A loader is normally used to discharge into conveyors or shuttle cars as the discharge into a tub requires high elevation of boom of the loader and it is not practicable in most of the cases.
- The loader has sometimes to load the coal by double handling and this reduces its output considerably.

Rocker shovel

- A rocker shovel consists of:-
  - A chassis fitted with crawler chain, pneumatic tyres or wheels for traction
  - A loader bucket shovel at one end
  - Motor for power
  - Necessary controls for fitting and for operation of the shovel
- The crawler chain equipped shovel is best for a dipping roadway (max. gradient one in four) as the rocker shovel or conveyor.
- In a rising drift roadway having a gradient of 1 in 6 or more, tyred rocker shovel, when loaded, raises problems of braking and control and a crawler chain shovel is to be prefered.
- A rocker shovel has a bucket or shovel at its front end which may be used for dumping the contents to one side (known as side dum loader) or behind it.
- The operator pushes the bucket into the pile of the blasted rock.
- The bucket scoops the material with an upward-and over motion for discharge into a tub or conveyor behind the loader.
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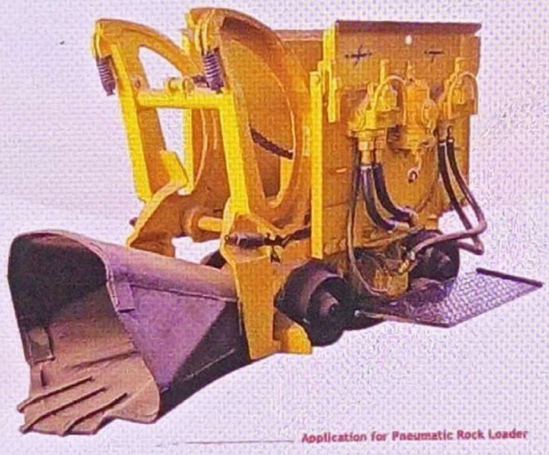


Application for Pneumatic Rock Loader

Cavo loaders

Loaders of cavo series are extensively used in matalliferous underground mines such as jaduguda, Rakha, Suria, khetri, Zawar and other mines.

The machine can be equipped for remote control operation also.

Cavo loader 310 has a bucket capacity of $0.13\ m^2$ and two traction air motors of 6.4 kW each.

Air motor for bucket is 7.2 kW.

The dumper is steered by running the two traction motors at different speeds.

If the motors are running at the same speed, but in opposite direction of rotation, the loader turns on the spot.

Travelling speed is 85 m/min.

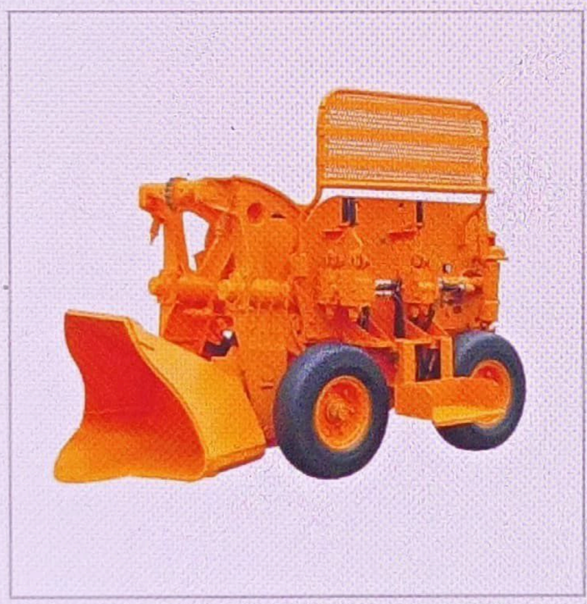
Air consumption 133/s.

The air motors are of vane type for traction as well as for bucket.

The loading capacity is $40 m^3/h$ in well piled fragmented rock: total weight 3150 kgf (with empty bucket).

The loader is provided with tyred wheels.

Machines used for loading at the working face and equipped with remote control operate normally 4-6 m from the chute.



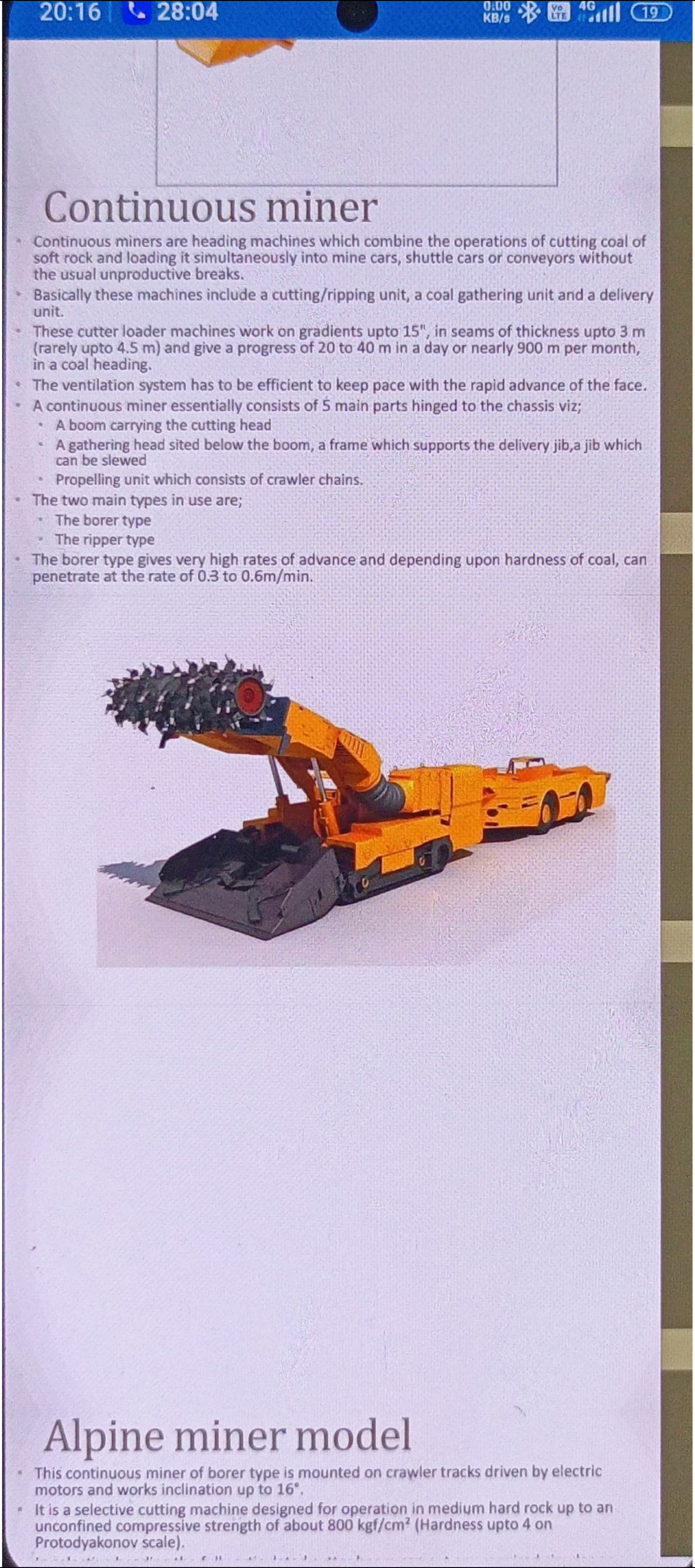
- The air motors are of vane type for traction as well as for bucket.
- The loading capacity is 40m³/h in well piled fragmented rock: total weight 3150 kgf (with empty bucket).
- The loader is provided with tyred wheels.
- Machines used for loading at the working face and equipped with remote control operate normally 4-6 m from the chute.

Continuous miner

Continuous miners are heading machines which combine the operations of cutting coal of soft rock and loading it simultaneously into mine cars, shuttle cars or conveyors without the usual unproductive breaks.

Basically these machines include a cutting/ripping unit, a coal gathering unit and a delivery unit.

These cutter loader machines work on gradients upto 15°, in seams of thickness upto 3 m



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- These cutter loader machines work on gradients upto 15", in seams of thickness upto 3 m (rarely upto 4.5 m) and give a progress of 20 to 40 m in a day or nearly 900 m per month, in a coal heading.
- The ventilation system has to be efficient to keep pace with the rapid advance of the face.
- A continuous miner essentially consists of 5 main parts hinged to the chassis viz;
  - A boom carrying the cutting head
  - A gathering head sited below the boom, a frame which supports the delivery jib,a jib which can be slewed
  - Propelling unit which consists of crawler chains.
- The two main types in use are;
  - The borer type
  - The ripper type
- The borer type gives very high rates of advance and depending upon hardness of coal, can penetrate at the rate of 0.3 to 0.6m/min.

Alpine miner model

- This continuous miner of borer type is mounted on crawler tracks driven by electric motors and works inclination up to 16°.
- It is a selective cutting machine designed for operation in medium hard rock up to an unconfined compressive strength of about 800 kgf/cm² (Hardness upto 4 on Protodyakonov scale).

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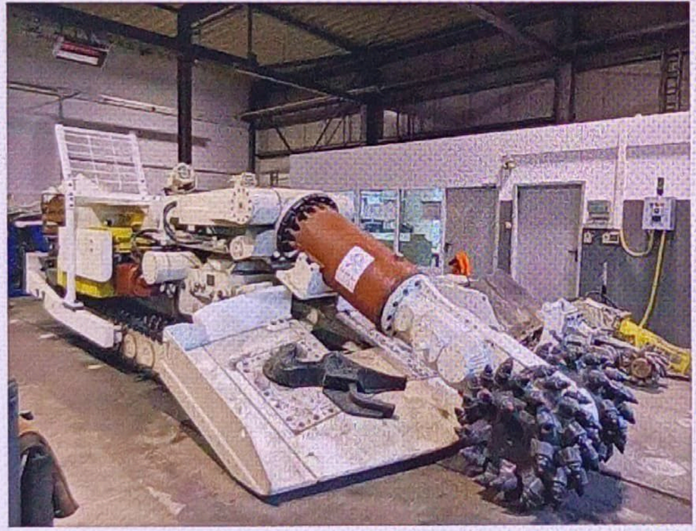
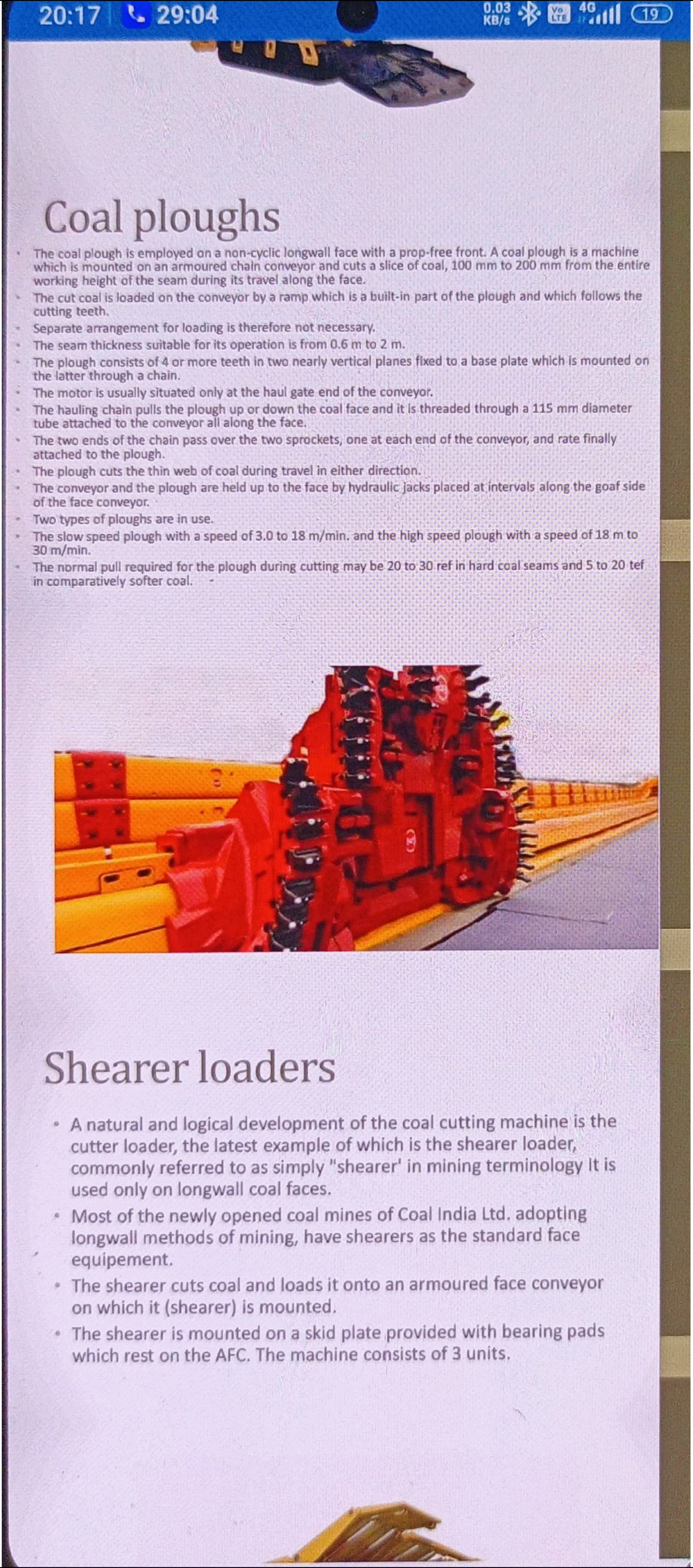
- It is a selective cutting machine designed for operation in medium hard rock up to an unconfined compressive strength of about 800 kgf/cm² (Hardness upto 4 on Protodyakonov scale).
- In selective heading the fully articulated cutter boom can cut any required circular or within the limits of 3.75 m in height and 4.8 m in width, if the machine is located on the centre-line of a heading.
- The cutting unit of the miner consists of the head laced with carbide tipped picks and driven by a water cooled 120 kW motor through spur-gear.
- Selection of the cutter head, picks and speeds is governed by the breaking characteristics of the rock.
- The cutter boom consisting of cutter head, gear and motor is mounted on the turret which provides horizontal and vertical positioning of the cutter boom.
- The loading system consists of a hydraulically adjustable apron with two gathering arms
- These move the ripped coal/rock into the single-strand chain conveyor located in the centre of the machine.
- The gathering arms are through bevel gearing by the chain conveyor reversing shaft.
- The chain conveyor is actuated by two 13.24 kW motors.



Coal ploughs

- The coal plough is employed on a non-cyclic longwall face with a prop-free front. A coal plough is a machine which is mounted on an armoured chain conveyor and cuts a slice of coal, 100 mm to 200 mm from the entire working height of the seam during its travel along the face.
- The cut coal is loaded on the conveyor by a ramp which is a built-in part of the plough and which follows the cutting teeth.
- Separate arrangement for loading is therefore not necessary.



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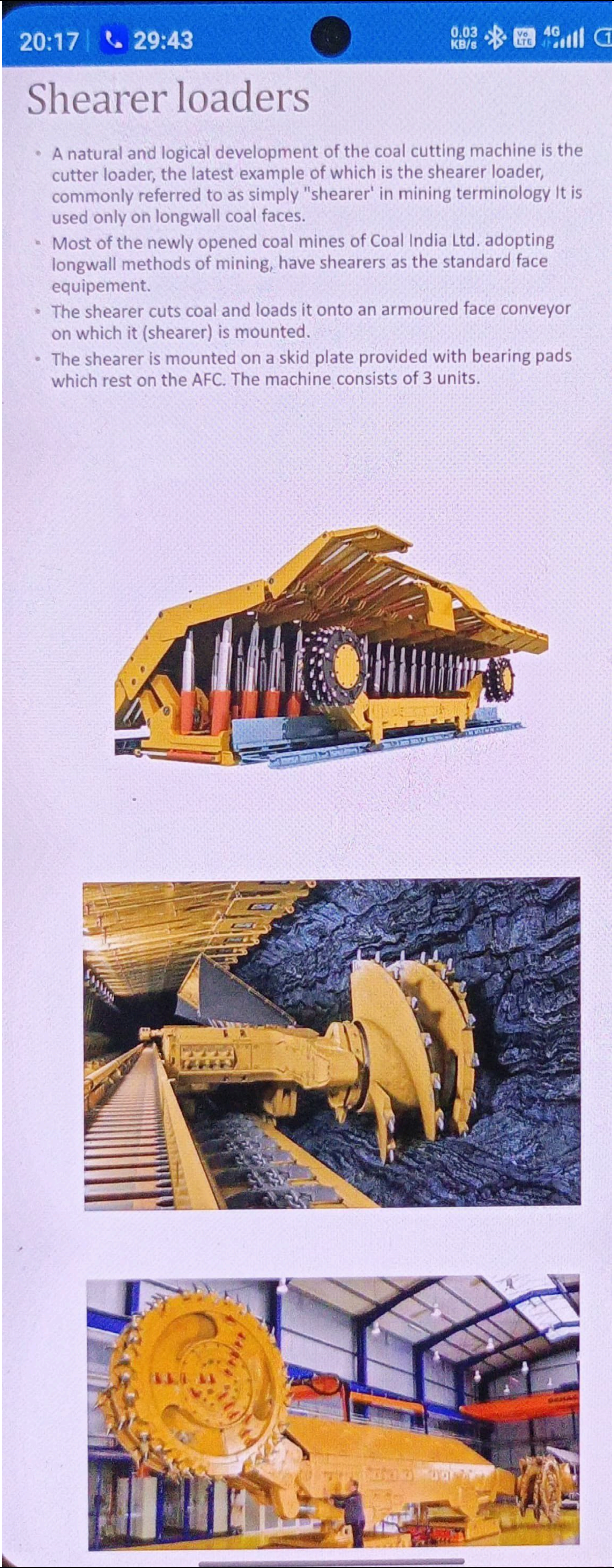
- The cut coal is loaded on the conveyor by a ramp which is a built-in part of the plough and which follows the cutting teeth.
- Separate arrangement for loading is therefore not necessary.
- The seam thickness suitable for its operation is from 0.6 m to 2 m.
- The plough consists of 4 or more teeth in two nearly vertical planes fixed to a base plate which is mounted on the latter through a chain.
- The motor is usually situated only at the haul gate end of the conveyor.
- The hauling chain pulls the plough up or down the coal face and it is threaded through a 115 mm diameter tube attached to the conveyor all along the face.
- The two ends of the chain pass over the two sprockets, one at each end of the conveyor, and rate finally attached to the plough.
- The plough cuts the thin web of coal during travel in either direction.
- The conveyor and the plough are held up to the face by hydraulic jacks placed at intervals along the goaf side of the face conveyor.
- Two types of ploughs are in use.
- The slow speed plough with a speed of 3.0 to 18 m/min. and the high speed plough with a speed of 18 m to 30 m/min.
- The normal pull required for the plough during cutting may be 20 to 30 ref in hard coal seams and 5 to 20 tef in comparatively softer coal.

Shearer loaders

- A natural and logical development of the coal cutting machine is the cutter loader, the latest example of which is the shearer loader, commonly referred to as simply "shearer' in mining terminology It is used only on longwall coal faces.
- Most of the newly opened coal mines of Coal India Ltd. adopting longwall methods of mining, have shearers as the standard face equipement.
- The shearer cuts coal and loads it onto an armoured face conveyor on which it (shearer) is mounted.
- The shearer is mounted on a skid plate provided with bearing pads which rest on the AFC. The machine consists of 3 units.



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